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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

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Forthcoming Events.

Institute of British Foundrymen.

JANUARY 2.

London Branch (Junior Section):—Ordinary meeting. Paper by G. C. Fierce.

JANUARY 3.

West Riding of Yorkshire Branch:—Ordinary meeting at Bradford. "Mould and Core Drying," Paper by G. E. France.

JANUARY 9.

Middlesbrough Branch:—Ordinary meeting. "The Manufacture and Properties of Malleable Castings," Paper by J. K. Smithson.

JANUARY 10.

Lancashire Branch:—Annual dinner at the Grand Hotel, Manchester.

Wales and Monmouth Branch:—Ordinary meeting at Cardiff. "An Indian State Railway Foundry," Paper by C. A. Howe.

The Small Fry.

Mr. S. H. Russell, in a very interesting address to the Lancashire Branch of the Institute of British Foundrymen, expressed no regret at the disappearance of 544 iron foundries in Great Britain. Mr. Ernest Wells, too, is known to hold the view that the steel-foundry industry suffers severely from over-capacity. We, too, have on various occasions expressed the view that the weeding-out of semi-derelict establishments is ultimately to the benefit of industry, yet there is another side to the picture, and several factors are of such import that they must be taken into consideration before justice can be done to the subject. Primarily, when trade is bad, the inefficient firm, through its policy of excessive price cutting, does give an impetus to the well-organised concerns to check their methods of manufacture and costing, with laudable results. In good times these semi-derelict concerns are capable of, and actually do, make profits. From a national economic point of view, they are a great potential source of wealth.

A
Happy & Prosperous
New Year to all our
Readers

A third factor is that they can rapidly undergo a metamorphosis, through an invention or new design, and become modern, progressive and worthy to rank with the best of modern establishments. There is, for instance, a foundry on the South Coast, which was a few years ago a typical country jobbing shop, carrying the usual attributes of poor lighting, no heating, untidiness, grime and fume. Here experiments were carried out with a minimum of overhead charges, a sensible control was instituted and a new design of a commonly-used casting evolved. As the profits mature from the developments, the shops are being reconstructed, and an enthusiastic personnel being created around what promises to be virtually a new local and important industry.

This type of development is more likely to be achieved in the smaller foundries having a wide-awake management, because in the large establishments so much thought has to be devoted to economies which will affect every type of casting made—sand handling, cleaning methods, mixture cheapening and so on. Thus, when the larger and progressive foundries announce that the smaller inefficient fry should be absorbed or go out of business, we would ask them to remember that they, too, were once small and possibly inefficient jobbing shops.

Unemployment Remedies.

The remedies proposed to the Government by Mr. Lloyd George for unemployment present one or two features of interest which can be considered quite apart from their political significance. They seem to be based on the plan that although industry has suffered through too-rapid deflation and return to the gold standard, this has at least established our credit on a high level and enables us to borrow as cheaply as any country in the world. The idea in these proposals is to make use of this credit by borrowing for productive schemes.

A conference of all engaged in industry is proposed, including not only industrial and commercial interests and trades unions, but also the banks and the distributive trades. The present situation is regarded as serious, and a state of emergency. A general reduction in all costs is suggested as essential to the recovery of British export trade, excluding the prices of imported raw materials. Revision of trade-union rules is explicitly called for, but all classes must make a sacrifice.

The banks are criticised because they have a controlling voice in industry through overdrafts and mortgages and so on, yet they take no constructive part in building up the industry. On the contrary, they are often a dead hand in development. The cost of distribution is regarded as too great, and the disparity between wholesale and retail prices too large.

Emphasis is laid on the need for exploiting new scientific development and of new inventions. The State, it is said, should facilitate industrial research and the wise application of invention. The Mellon Institute of Pittsburgh is cited as an institution which might be copied here with profit, helped and financed by the State but not being a State enterprise. It should be free to sell or develop its discoveries on commercial lines.

There seems to us here a certain confusion of idea between research and invention and a certain lack of understanding of the functions of the Mellon Institute. That body really offers its staff accommodation and equipment for a period. They may be financed by manufacturers' associations to develop a new type of wallpaper, a new tooth paste or a new soft drink. We believe that the specialised research associations developed in this country are infinitely more satisfactory means for the prosecution of research and invention than a heterogeneous group of workers gathered in the walls of a single institution. Furthermore, invention cannot be carried on to order. Invention is often a part of industrial research, but it is hopeless to put down a list of desirable inventions in the hope that somebody may be stimulated to fill the want. Valuable ideas are not, in these days of highly-developed industries, so easily snared.

XUM

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Non-Corrosive Metal.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—I wish to know of a mixture for casting a non-corrosive metal for the manufacture of cocks and valves, for use in a wine distillery. Pure tin appears to be too soft, as it is difficult to keep the plug tight owing to wear. Tinning and nickel-plating brass cocks lasts a very little time. Block tin pipes are being used, but these are very susceptible to mechanical damage. I shall be glad if any of your readers could put me in touch with a supplier of tubes of a non-corrosive metal.—Yours, etc.,

J. H. QUICK.

The Madeira Supply Company, Limited,
Rua da Ponte de S. Lazaro, No. 4, Madeira.
December 15, 1930.

The Late Lord Melchett.

We sincerely regret to announce the death of Lord Melchett, which occurred last Saturday. Lord Melchett was the principal guest of the Institute of Foundrymen on the occasion of an international congress held in 1926. His speech that evening revealed a knowledge of and a sympathy with the foundry industry such as has rarely been exhibited by men of equally high political standing. He appreciated particularly the work of the foundry foreman, insisting that he possessed knowledge of a type never to be found in text-books. He acknowledged with gratitude the work the foundries were doing in the direction of the provision of high-grade castings for the great chemical industries which he directed and served.

Whilst his work for the metallurgical side of foundry practice will always be appreciated, Lord Melchett's name will probably go down in history because of his practical attempt to rationalise the oft-times delicate relationship between the employed and employer. Starting off with the premise that "we are all in the same boat," he, in co-operation with Mr. Turner, then President of the Trade Union Congress, initiated conversations with the object of creating conditions for the all-round betterment of "sailing" conditions. This unfinished work is permeating all modern industrial thought and action, and to-day is the most powerful incentive for good in the conduct of negotiations dealing with industrial relationships.

By the passing of Lord Melchett the foundry industry has lost one of its best friends amongst the financial and industrial magnates, as he, above all others, realised its basic character and worth.

Catalogue Received.

Foundry and Heat-Treatment Equipment.—We have on occasion drawn attention to what we considered defects in some of the publicity matter issued by August's Muffle Furnaces Limited, of Thorn Tree Works, Halifax, but their November bulletin, which takes the form of a folder, reaches an extremely high standard. It certainly gives a clear message of confidence to tackle a complete line of problems. It stresses service in the paragraph "What we do" and business acumen in "What we make." These paragraphs, taken in conjunction with the illustrated details of plants furnished, should, in our opinion, make the recipient eager to know more about the activities of the senders, and this is the real object of the bulletin.

Prominent Foundryman Honoured.

MR. WESLEY LAMBERT AWARDED C.B.E.

The foundry industry throughout the whole world will learn with the greatest satisfaction that Mr. Lambert's successful presidency in June, 1929, over the 3rd International Foundrymen's Congress has been recognised by His Majesty's Privy Council by the conferring of the decoration of a Commander of the Order of the British Empire upon him.

No more popular representative of the foundry industry could have been chosen, nor has a decoration ever been more worthily merited. Mr. Lambert has been actively associated with every recent development which has taken place within the foundry industry, except, of course, the industrial relationship of its personnel. Primarily he has actively supported international technical co-operation, and has participated in all the various European congresses, culminating in his chairmanship of the London convention. He devoted a great amount of time and energy to the work of the test-bar committee, the result of which has been the creation of an acceptable basis for acceptation of iron castings. The work which he personally has enjoyed the most has been in connection with the education of the younger members to the industry, not merely in committee, but by personal service to metallurgical classes and junior sections.

Mr. Lambert received his technical training at King's College, and after graduating spent some years in Government service at Woolwich Arsenal. For a time he was "loaned" to the Turkish Government in connection with the metallurgical training of their naval technicians. For this work he was decorated by the Sultan. Some years before the war he was appointed metallurgist to Messrs. J. Stone & Company, Limited, of Deptford—a position he still holds. Mr. Lambert is a member of a large number of scientific societies, and was last year elected to the Council of the Institute of Metals. On behalf of the foundry industry we offer very hearty congratulations on this well-deserved recognition of his work for the industry through the medium of the Institute of British Foundrymen.

Notes from the I.B.F. Branches.

Lancashire.—At a meeting of the Junior Section of the Lancashire Branch of the Institute of British Foundrymen, held on December 20, Mr. H. V. Grundy presiding, MR. J. G. ROBINSON, of Halifax, gave a lecture on "Moulding a Vertical Water-Jacketed Gas-Engine Cylinder." The lecture detailed every phase of its development from the drawing to the machining of the casting.

An enjoyable discussion took place, and Mr. Robinson answered questions on blacking moulds, headers, runners, defects in bore of cylinders, mixing of metals, venting pocket cores, studs, chills, anchoring cores and other subjects. A few words by Prof. Rhead, late of Manchester College of Technology, were especially appreciated by the audience, who gave him a warm welcome on his first visit to the Junior Section. A hearty vote of thanks was proposed by Mr. Platt, and seconded by Mr. Poole.

Weight of Cast-Iron Cylinders.—The following formula is reliable for estimating purposes:—$(A + T) \times (T \times 8L) \div 1{,}100$ = weight in cwts.; A is inside diamater; T = thickness; L = length.

Heating.—Approximately 18 sq. in. of grate area in the average boiler will be sufficient for heating from 35 to 45 ft. of 4-in.-bore piping. The heat given out will be ample for office or workshop purposes. The above is for hot-water heating and not steam.

Random Shots.

I have occasionally mentioned in this column books which busy men might be interested in reading as a relief from business cares, and the subject is particularly appropriate just now, for books seem to have been chosen very generally for Christmas gifts.

* * *

Previously my comments have been confined to detective stories, and these are astonishingly popular among all classes of readers. These, however, tend to become more and more elaborate and tortuous in plot, and consequently further and further from reality. A good illustration is furnished by the "Roman Hat Mystery." This was a first-class yarn of the type, but the same author's more recent "French Powder Mystery" is so involved that it is disappointing.

* * *

In consequence, one turns to books of another type, and I have found an excellent substitute in various books dealing with the efforts of prisoners of war to escape. One of the best known of these is "The Escaping Club," by Evans. This deals in the main with escapes from German camps, chiefly forts and prisons, and gives a thrilling and full account of the careful and painstaking preparation and subsequent adventures.

* * *

Even more exciting is Jones' famous "Road to En-dor," which deals with the escape of two British officers from a Turkish prison in Anatolia, several hundred miles from Constantinople. The book is a scream from beginning to end, for it mainly deals with fooling Turkish interpreters and officers by means of spoof experiments in the occult. No mere description can do justice to one of the most gorgeous pieces of leg-pulling in history, for the ghost (whom they called the Spook) at one point was actually giving orders to the Turkish War Office.

* * *

This book as fiction would be incredible and too far-fetched, and one can only feel sorry that the author and his partner, after their terrible hardship, did not succeed in getting their freedom earlier, for they managed it a fortnight before the armistice. Both these volumes are available in cheap editions, and can be warmly recommended to anybody who likes an adventure story.

* * *

Another book that has interested me recently in its cheap form is the life of Marshall Hall, the famous lawyer. This book deals with many of his criminal cases, and is far more interesting than any detective story. It will beguile many a railway journey.

* * *

In this country we occasionally become sarcastic about the jobs obtained by defeated candidates at Parliamentary elections, and the same appears to be true of the States. The Democrats there tell a good one about a defeated Republican candidate at the recent election who offered his services to a circus proprietor. The latter engaged him to replace an ape which had died. The applicant had to get into the preserved skin of the ape and live in its cage.

* * *

To his horror he found a lion asleep in the cage. He shrieked to attract the proprietor's attention, but he only succeeded in waking the lion, who came to him and struck him in the face with his paw and said: "Don't make such a din, you fool; you're not the only defeated Republican candidate."

MARKSMAN.

The Production of an Aluminium-Alloy Casting.*

By A. Harley (Vice-President, Institute of British Foundrymen).

Introduction.

The increasing use of light-alloy castings, due to the development of special alloys and the enhanced physical values obtained by heat-treatment, has involved the author's concern in the production of these castings. It has been interesting to note the different methods required. In fact, many troubles arose from preconceived notions based on the experiences with other metals. This Paper will deal only with certain practical conclusions gained from experience in actual production, and not the result of any special research. These conclusions are not put forward in a dogmatic manner, and discussion or even criticism will be welcomed.

To anyone accustomed to the founding of cast iron or cast steel, the production of castings in aluminium alloys seems child's play. Disillusion may be delayed for some time, but is inevitable. Aluminium constitutes a metal that is easily alloyed, easily melted, easily cast, and as a rule the castings look beautiful when taken from the mould. There may be a small crack here and there, or a sink in the metal, but the experienced foundryman feels that he can put such a matter right easily. It is only when

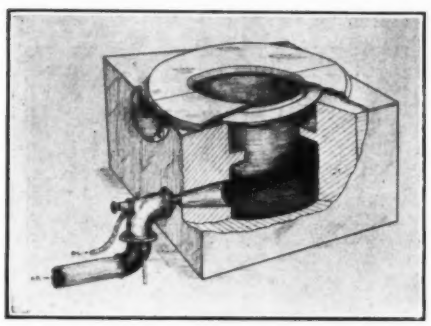

FIG. 1.—DIAGRAM OF FURNACE USED FOR MELTING ALUMINIUM ALLOYS.

the castings have been through the machining operations, however, that he begins to realise that while aluminium may be fair to look upon as cast, it has a quality of deceitfulness which is distinctly annoying. One now begins to take the job a little more seriously, and discover that this beautiful metal has certain disconcerting properties. It appears to have the ability to absorb most of the known gases, and, no doubt, some of the unknown as well. These gases begin to emerge when the metal is cooling in the mould, but owing to the rapidity with which a skin is formed, they are imprisoned just underneath the surface of the casting.

Again, whilst aluminium can be easily melted, it can also be very easily over-heated in the furnace, and thereby ruined entirely for important work. The lightness of the metal is in some ways a disadvantage to the founder, as there is not the same weight as in other metals pushing the air out of the mould. It is also liable to mis-run, owing to the rapidity with which it cools, and also to the low temperature at which it must be cast if the casting is to have the best physical condition.

To conclude these general remarks, it may be noted that aluminium alloys begin to absorb gases freely about 740 deg. C., and therefore higher temperatures than this are to be avoided. The liquid shrinkage of the metal is considerable, and averages about 1 per cent. for each 100 deg. C., and the solid contraction averages 1 in 80. Where the facilities exist, it is better to make up the alloys in the foundry from virgin-aluminium ingot, as metal can be bought with a high degree of purity and usually free from absorbed gases. Many alloys of aluminium, however, are rather complex in composition, and can only be prepared properly under scientific control. In such cases it is probably better to buy the prepared alloy. In making high-grade castings, bought scrap should not be used.

Melting.

There are many types of furnaces used for the melting of aluminium alloys. The choice will

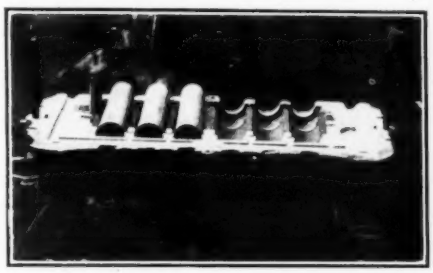

FIG. 2.—SHOWING PARTLY-ASSEMBLED CYLINDER MOULD.

depend to some extent on the class of work dealt with. It is not proposed to consider the relative advantages or disadvantages of the different kinds in use, but merely state briefly personal practice. A diagram of the furnace used is shown in Fig. 1. It is simply a square casing of mild-steel sheet lined with good fire brick to 24 in.

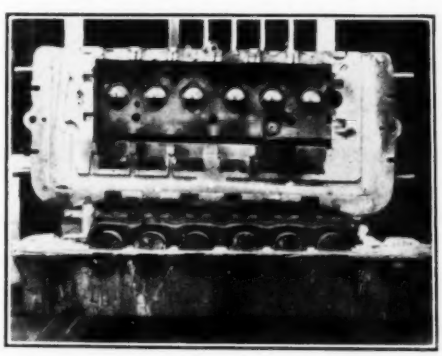

FIG. 3.—COMPLETELY-ASSEMBLED CYLINDER MOULD.

dia. The melting pot is of semi-steel, 17 in. dia. at the top, and from $\frac{1}{2}$ to $\frac{5}{8}$ in. in thickness. The capacity of the pot is 180 lbs. of molten alloy. The average life is 80 heats, and the cost of the pot is approximately 6d. per cwt. of metal melted. These pots are coated with a refractory wash of plumbago and whiting to prevent the absorption of iron by the aluminium. A baffle wall is built into the furnace and encircles the pot except for a 4½-in. space just over the entrance of the flame. This keeps the heat down. The outlet for the flame is at the rear, the area of this being 12 sq. in. Blast at a pressure of 12 ozs. per sq. in. is supplied by a small direct-driven fan.

The furnaces are furnished with an oil supply from tanks which are cylindrical in shape, and fixed at a minimum height of 10 ft. from the ground. They have a capacity of 125 galls., and are fitted with glass gauges on which is marked a carefully graduated scale. Ordinary fuel oil is used, and the design of the burner permits of the exercising of accurate control of the flame.

No serious objections have been found to the use of an iron pot, and the economy obtained is self-evident. With a furnace of this type, and using ordinary care, the oxidation of the metal and absorption of gases can be reduced to a minimum. It is almost unnecessary to state that temperature control is essential. The pyrometer must be kept in constant use, and the accuracy of the instrument regularly checked. The metal is ladled out, care being taken to disturb the metal as little as possible. There are other types of furnaces in work, but for convenience and economy the type described is favoured. At the same time, there is much room for improvement in this direction, and a good deal of work is being done in the design of furnaces using electricity. This method would appear to be ideal, if the melting costs can be kept reasonably low. Electricity does not compete with oil for melting at its present price.

General Casting Principles.

Assuming that one has got the molten metal, of the correct composition and comparatively free from oxide and gas inclusions, one may at this stage consider a few of the general principles to be observed in pouring an aluminium-alloy casting. The whole matter may be summed up briefly by stating that the molten

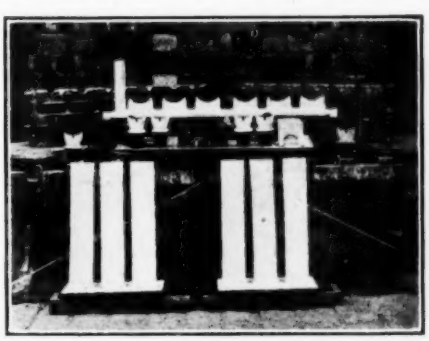

FIG. 4.—COMPLETE SET OF CYLINDER CORES.

metal must be introduced into the mould at the lowest possible temperature, as quietly as possible, as quickly as possible, and everything done to insure quick and uniform solidification.

If this dictum be accepted, it will govern action on many important matters:—(*a*) A number of small runners rather than one or two large ones will be favoured; (*b*) the shape and disposition of the runners will be arranged to cause the minimum of disturbance on entering the mould; (*c*) chilling the casting wherever necessary, and use heavy risers for "feeding" as little as possible will have consideration; (*d*) to assist uniform solidification provision will be made for that metal to enter at thin portions of the casting and finish at thick sections, and (*e*) the air in the mould will be allowed a free exit, so that no resistance is offered to the flow of the metal. Many mis-run castings are due to this.

The foregoing can only be stated as general principles. The design of the casting, the method of production and the purpose for which the casting is to be used, will influence the method of running and decide where chills should be placed and where feeders should be utilised. For example, if a casting has to withstand high pressure tests, chills will be preferable. On the other hand, the use of chills requires very careful study and feeders are often a convenient, and perhaps easier, method of curing contraction troubles. It must not be forgotten, also, that chills have to be made and may be a source of trouble in themselves through sweating, particularly if green-sand moulds are in use; whereas

* A Paper presented before the Scottish Branch of the Institute of British Foundrymen, Mr. J. Miller presiding.

XUM

feeders may be placed wherever wanted without delay. Moreover, it may happen that a section is too thick to chill effectively, or the thick section may be inaccessible. Feeders are then employed.

It is not good practice to have metal running over a chill, as this nullifies the effect. The use of feeders does not, however, improve the physical condition of the casting, having a tendency to coarsen the grain and thereby reducing the strength. It is obvious that where strength or closeness of grain is not of prime importance, feeders are very useful. With intricate castings, both chills and feeders may be necessary.

Methods of Production.

It is proposed to present a few notes on the production of three aluminium-alloy castings, namely:—(1) A six-bore cylinder block (run from the bottom—Figs. 2 to 5); (2) cylinder-head (run from the top—Figs. 6 and 7), and (3) a piston (run from the side—Fig. 8).

Fig. 2 shows a partly-assembled cylinder mould with three barrel cores in position. Also the bottom jacket core and the port cores, which are part of the induction-pipe core, can be seen projecting through the jacket core. These port cores do not come in contact with the barrel core, and a thickness of metal is left even after the barrels are machined. This is afterwards milled out, thus ensuring the accurate position of the ports. The completely-assembled mould is shown in Fig. 3. The exhaust-port cores can be seen peeping through the top part of the mould.

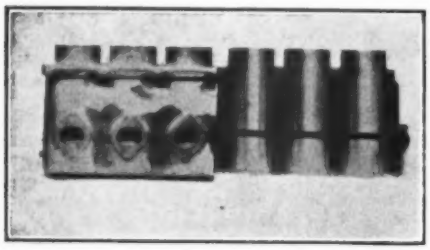

FIG. 5.—PART SECTION OF FINISHED CYLINDER.

With the exception of these all the other cores are assembled in the bottom part of the mould.

Fig. 4 illustrates a complete set of cylinder cores, 19 in number. These comprise six barrel cores, two jacket cores, one induction-pipe core, six valve cores and four miscellaneous cores—two for covering the pipe prints, one for forming the end of the pipe, and one small round core. The barrel cores are rammed up in halves to facilitate the accurate placing of the chills; there are eight chills in each core. These cores are made of ordinary sand, weak, and containing as little moisture as possible; they must be just strong enough to carry the chills. The jacket cores are made of silica sand of uniform grain size. The amount of artificial band must be only about 60 per cent. of the quantity used for a cast-iron cylinder (2½ per cent. by weight). The long induction-pipe core requires careful making and handling. It must be well vented and supported by wires to prevent distortion; it is made of weak ordinary sand. All the cores are coated with a mixture of French chalk and plumbago in water. The finished cylinder is shown in section in Fig. 5.

Fig. 6 shows two views and a section of a cylinder-head casting. These heads are cast at a temperature of 690 deg. C. The small runner and its position should be noted. The weight of the casting is 3¼ lbs., whilst the runner weighs 2 ozs. A group of cylinder-head mould and core parts is illustrated in Fig. 7.

Fig. 8 depicts a piston die closed and ready for casting. The cost of making these dies is fairly expensive; the mould is of cast iron and the core pieces of tungsten steel. The entire mould is sprayed with a protective coating, the runners being sprayed with a slightly thicker coating to help feeding. The metal is poured at 710 deg. C.

These castings are all important parts of the same engine component, and have to meet very stringent tests. As castings, they must be entirely free from any kind of defect. The metal in the castings must retain a high proportion of the theoretical strength. They must be dimensionally accurate, and in the case of the cylinder must withstand severe pressure tests.

The cylinders are cast entirely in sand; the heads are cast in metal moulds with sand cores, whilst the pistons are cast in all-metal moulds

FIG. 6.—SHOWING TWO CYLINDER-HEAD CASTINGS AND SECTION.

and cores. The cylinder heads and pistons are cast in No. 1 alloy, and the cylinders in No. 2, some particulars of which are detailed in Table I.

The sand for aluminium moulding should be fairly weak. No milling is done, but a little red sand is added from time to time, and the mixture put through a sand-throwing machine, which

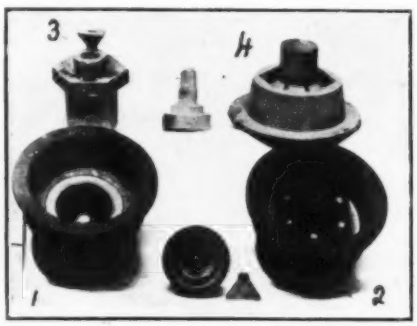

FIG. 7.—CYLINDER-HEAD MOULD AND CORE PARTS, SHOWING (1) METAL MOULD, (2) METAL COREBOX, (3) CASTING WITH RUNNER AND (4) CORES.

thoroughly aerates it. Each barrel of the cylinder is chilled to obtain a close grain and good finish, but no liners are cast in. For piston

TABLE I.—*Physical Values of Alloys.*

	B.E.S.A. alloys			Daimler alloys.		
	2 L5	2 L8	3 L11	Chill 1	Cast 2	Sand cast 3
Y.P. (tons per sq. in.)	—	—	—	15	12	12
U.T.S. (tons per sq. in.)	11	9	9	17–21	17–21	16–19
E. (per cent. on 2 in.)	3	nil	3	1–0	5–8	3–5
Brinell No. ..	—	—	—	120–140	90–95	85–109

cores, where external chills are used, 10 per cent. of red sand is added to the old sand, and the mixture slightly milled. This gives good results, and the castings are very smooth inside. The incorporation of a little sawdust has been found very beneficial for aluminium, especially in the core sand, as its presence decreases the resistance of the core to the contraction of the metal. The method of casting test-bars is illustrated in Fig. 9. The cylinder is machine-moulded, the moulding boxes usually being made from low-grade aluminium scrap. The cylinder cores are all dried, but the mould itself is not.

DISCUSSION.

The CHAIRMAN (Mr. Miller) said that he was sure that the lecturer had aroused their interest and held their attention in a marked degree. He himself was not connected with aluminium foundry practice, and knew nothing of this metal and its alloys, although something akin came under his attention.

MR. N. M'MANUS asked if the lecturer adopted any definite method of determining the thickness of the chills he used. If, for instance, the section was 1 in. in thickness, what thickness of chill was used? Was it a case of trial and error, or could it be calculated?

Thickness of Chill.

MR. HARLEY replied that it was really a case of trial and error. The object of a chill was to obtain a close grain throughout the section of the metal, and the thickness of the chill was proportionate to the thickness of the section.

MR. M'MANUS: What diameter of test-bar was used in the tests shown? Was it 1 in.?

MR. HARLEY: The test-bars are cast to shape,

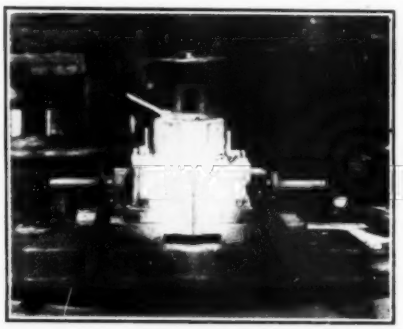

FIG. 8.—PISTON DIE CLOSED AND READY FOR CASTING.

and the two examples illustrated were ¾ in. dia. and ½ in. dia. respectively on the tested portion.

MR. J. R. WILSON said that he was interested in the chills used. He noticed that Mr. Harley specially mentioned brass chills. Were brass chills better than cast iron?

MR. HARLEY said he thought brass chills were better than cast iron; whilst the latter were cheaper, they did not last so long.

Casting Temperature.

MR. R. D. LAURIE said that he noted that Mr. Harley cast into sand moulds at a temperature of 720 deg. C. He would like to know if he had any trouble with gases. He had found that if he cast over 700 deg. C. there were always a quantity of pin holes, and preferred to cast at 650 deg. C. If he cast at any temperature over 700 deg. C. he had trouble.

MR. HARLEY replied that it had been proved that aluminium and its alloys did not absorb gases readily at temperature below 740 deg. C. Temperatures of 730 deg. C. downwards were fairly safe, but the composition of the alloy and the rate of cooling had some bearing on this point.

MR. LAURIE: What of "Y" alloy, for instance?

MR. HARLEY said that this was a difficult alloy to cast, but he had done so at a temperature of 720 deg. C. with satisfactory results.

(*Concluded on page* 13.)

Foundries—and Foundries.*

By S. H. Russell (Past-President of the Institute of British Foundrymen).

This Cinderella Myth.

I think that if I had known what really would be the gist of this address in July last, when I was invited to read a Paper, I should not have chosen the above title, but rather "This Cinderella Myth."

Why are we so smug about this title, the Cinderella of the engineering industry, a title bestowed upon us by eminent professors and engineers ever since I can remember, a title I once complacently accepted, and maybe even quoted, but now resent?

What does this imply? Cinderella—if my memory serves me correctly—was a modest, beautiful, rather retiring, and wholly unenterprising individual. I ask you, does any of this fit the foundry industry? Again, after her visit to the ball and the fitting of the glass slipper, Cinders—to use her more modern designation—attained everlasting felicity. Do we imagine that our industry will ever attain that, and, even if it were possible, is it really desirable?

There are, of course, the Ugly Sisters. Well, perhaps we do not find so much difficulty in finding someone to fill their parts. I suggest that the buyer and the engineer or the user can be more or less successfully cast for these places.

What if the work is dirty, often unattractive, not too well paid, many of these defects can be remedied or palliated. Cinderella sat in rags by the hearth because she had no alternative. We seem to place ourselves in a similar position voluntarily.

The First Essential.

Excluding for a time those foundries entirely devoted to the mass production of castings, or who are able to produce all their castings by the use of machines, I say excluding these foundries—who are the most valuable men in the shop—your chemist, your foreman? Well, these are important persons. It is impossible to run a foundry profitably unless the executive is capable. But it is impossible to run a jobbing foundry *at all* unless you have the moulders. Moulders are still the first essential in many or in most foundries, and will be for a long time. This, of course, is a well-recognised fact, and how we complain that to-day we cannot obtain the class of boy we should like either as apprentices or improvers in the foundry, and we lay the blame on to a thousand and one things.

Has the industry ever been able to do this? Think of all the really good moulders you know—those wonderful men who know whether facing sand is right by its look and its feel, who know how hard to ram, where to reinforce the mould with sprigs, etc., where to run, how much weight is necessary on the box, and how much metal will be required—I say, think of these men. Most of them middle-aged or even aged men, and honestly ask yourself, is their education such as to indicate that they were considered by an earlier generation a desirable sort of boy? Do they appear to come from the sort of homes you think desirable? Obviously in most cases these men had no educational advantages, no moral advantages. Yet where and how did they acquire their skill?

We still require many moulders, and we have got to find ways and means so that the rising generation of moulders can attain or surpass the skill of the present generation. You will have gathered from my remarks that I suspect that the quality of juvenile labour available in the foundry is comparable with the quality of the earlier generation, and I imagine you will agree with me when I say that we have not succeeded in training this labour to be as skilful as the older generation, and it is obviously necessary to try and find out why this is so, and also to do all we can to remedy the failure.

Twenty-Five Years' Progress.

What are the fundamental differences between the foundries of 25 years ago and to-day? There was a 53-hour week then (please don't think I am going to advocate a return to that), but how leisurely that 53-hour week was compared with to-day.

Sand-mixing machines were elementary, almost unknown. Many moulders mixed their own facing sand, made their own cores, and had plenty of time in which to examine and discuss the various problems of any particular mould as they arose. Much of the work was day work, and, most valuable point of all, if engaged on a job of any size, they usually had a lad working with them, who had, of course, invaluable opportunities of learning the why and wherefore of things—often expressed to him in a very crude but effective way, and those boys are our leading moulders to-day.

Conditions are now very different. Good moulders are scarce, hours per week are shorter, and everything possible to obtain a larger output per moulder hour is done, to such an extent that the moulder now does only about two-thirds of the operations he previously did, and in many cases never sees the castings he makes, unless they prove defective. The youth who used to assist him is replaced by all sorts of mechanical contrivances, by standardised shop tools, and by gangs of men specially organised to do several of the items originally carried out by the moulder and his assistant, and the old method of training has disappeared in most shops.

And so, if you agree with me that the foundry boy of to-day is of the same average ability as the boy of 25 years or so ago, and you also agree that the methods by which the present generation of moulders were trained do not now exist, what is Cinderella to do? Wait for the Fairy Godmother? Well, most of us are too materialistic for that, and will say instead that we have been trying for years to do something about it, that leading authorities have read Paper after Paper on the problem, many committees have met, foundry classes are encouraged at the technical colleges, and yet up to now we have attained but little improvement in the calibre and skill of our younger moulders.

The solution of the problem as I see it is that it is necessary to concentrate on the production of a limited number of moulders, with a sufficiently broad experience to enable them to tackle a variety of work with reasonable hope of success. And to do this I consider that every employer in a foundry should undertake to provide practical opportunities for training to the most promising boys he employs, and that he endeavours to complete the training of 5 per cent. of his moulding strength every year, so that in 20 years he will have produced sufficient qualified moulders to entirely re-man his shop.

Please do not think that by emphasising this method of training I have no respect for or sympathy with the technical education of foundry youths. Wherever facilities exist everything possible should be done to encourage attendance at technical colleges, and, if the right type of boy is available, to persevere with part-time training schemes.

Foundry Certificates.

So much progress has been made with the scheme for a nationally-recognised craft certificate that it is almost certain to be in complete operation by the next school year, and at long last we shall have a certificate of foundry knowledge and craft which will be given equal recognition up and down the whole country. Developments in machine-moulding methods, in mechanical ramming and in the use of power generally will still go on, and the man who can most readily apply these methods and developments is the educated man, who has a thorough grounding in the technical and practical side of foundry work. More and more shall we look to the use of mechanical means to enable the foundry to retain its position in the economic sphere, and it is on this side of the industry that the better-educated boys and men will more easily make headway, because the development of new and cheaper methods of production has an instinctive appeal to an educated man. It is also, of course, obvious that the youths who take full advantage of the education facilities now available will have much better and more promising opportunities of obtaining positions as charge hands, foremen and superintendents.

I believe that, providing sufficient money is spent in tackle, pattern coreboxes and equipment, nearly every essential casting required can be produced by the aid of semi-skilled labour and skilled supervision, but at what a cost and a hopelessly uneconomical proposition, because in addition to the prohibitive cost of the tackle, sacrifice in design and compactness would frequently have to be made to simplify the casting. And so I state that the leaders of industry in the foundries have got to forsake some of their beloved production methods and concentrate on the preservation of a reasonable proportion of craftsmen.

And a very fascinating and interesting occupation this is, I imagine, once you really enter into the spirit of it. It is useless sighing for nice, quiet, well-educated boys who understand what refractory, porosity, bond, etc., mean. Mention these words to your best moulders to-day and they merely look blank. No, let the man who thinks he has mastered all these intricacies himself and that he knows all about it, frankly meet and discuss with the men who are going to make the castings, the method of producing new and difficult parts, or improving upon the existing tackle, and also the why and the wherefore of all wasters. His respect for the uncanny wisdom of his moulders will soon grow, he will learn to sort out the wheat from the chaff, and, with patience, he will get his own point of view intelligently understood in his own shop and gradually raise the technique of his men. The juniors will most probably make the most scrap, and the supervisor has a golden opportunity here both of imparting a little knowledge and of sizing up his reinforcements.

The Ugly Sisters.

Now let us consider this tiresome simile of Cinderella a little further and have a look at the Ugly Sisters. In the fairy tale they are coupled together, and so I think that we can consider the buyer, the engineer and the user together. How often we look with envy at these lucky sisters, able to sit back in their coaches and drive off to royal balls whilst we remain humbly behind working in our kitchens.

It is not within the scope of this Paper to consider the ethics, the morals, or the character of the people who receive our prices and allocate the orders, but my own impression is that with firms of repute the success or otherwise of the would-be supplier depends upon the quality, a reasonable price, and the service offered when orders are obtained, rather than upon the use of shady tactics.

But we have got to consider the foundryman as a salesman, and a very bad salesman he usually is. Why is it so frightfully difficult to get a foundryman to face facts, and even to realise that the cost of every type of casting made in his shop is different from the cost of

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* An address given to the Lancashire Branch of the Institute of British Foundrymen, Mr. Roy Stubbs presiding.

every other type? How many hundred foundries still take but one cost per month, that being a monthly per cent. cost of all castings made in that month, and taking that as the basis of their estimate for further work?

When one sees how successfully foundrymen have combined to facilitate the exchange and development of scientific knowledge amongst themselves, it is amazing to find that they make so few attempts unitedly to consider and adjust their costs and selling prices.

Rationalisation.

We have already had our attention drawn several times to the very interesting and full report of the meetings of the German Iron Foundry Owners' Federation printed in THE FOUNDRY TRADE JOURNAL on September 18 last, but will you forgive me if I read to you a short extract from Dr. Geilenkirchen's speech as follows:—

"If the German Iron Foundry Owners' Federation was endeavouring by teaching the proper method of cost calculation, as well as by amalgamations on a sort of combine basis, to protect its commercial foundries from the effects of these conditions, its object was not to increase the price of cast products to the detriment of public economy, but to save from ruin an entire branch of industry which was of vital importance to Germany's economic life.

"At the same time it was, of course, necessary that precisely these detached foundries should specialise more than hitherto and so create the essential conditions for increasing their output and cheapening the cost of production; further, they must take advantage of all the modern achievements of technical science in respect to working and organisation so as to enable them to work more economically than hitherto, even without large capital expenditure."

There you have in a nutshell the solution of the problem facing the British foundryman of to-day. There is nothing dishonourable in making a reasonable profit on the manufacture of castings, but it is dishonourable when a profit is made to take it all out of the business. Economic conditions are and will be such that only the firms that can produce and sell their castings at a comparatively low price will ultimately survive, and to do this it is necessary to take full advantage of every development, and consistently to employ a proportion of the profits earned in the improvement and modernising of plant and equipment.

Why is there all this fear and mistrust of trade associations? I know of an association which soon found itself faced with problems which necessitated the use of an agreed system of costing to enable it to decide whether certain prices quoted were justifiable or not. Considerable care was taken in arriving at a satisfactory system of costing, which, after being approved, was circularised to all members. One member wrote back immediately saying that it was not the function of the association to teach him how to cost, and resigning his membership. That sort of spirit takes us nowhere.

Founders' Real Competitors.

May I be permitted to repeat what I said nearly two years ago, on the occasion of the International Convention? I then asked, *Who* is your *competitor?* and quoted from an article which asked the same question of the "village blacksmith": Who was his competitor—the smith in the next village or the little factories in our rural towns? No, Henry Ford was their competitor, the man who taught the world how to produce cheap and reliable cars, and he it is that has put the shutters up of so many of our smiths and farriers. And the real competitor of every ironfounder or brassfounder is the man busily engaged in producing alternative materials, whether fabricated steel, drop forgings, or the many other processes which produce articles formerly cast in a foundry, and which admittedly possess certain qualities not to be obtained from a sand casting.

It is vital that we keep fully abreast of the times, ready to adopt any process, or even to produce a new material, in order to remain in the van of progress. I know of a foundry built 30 years ago, built for the manufacture of two types of castings only, builders' columns and cast-iron windows. To-day it is a rarity for either of these to be ordered, even singly, and yet under the same management, and even with some of the same moulders, that foundry now produces high-quality machine-tool and general machinery castings. The old plant has all gone or been modernised, and the works which, had they attempted to adhere to the original work, would be now derelict, are in normal times busy and flourishing.

Extraordinary facilities are to-day placed at the disposal of the foundryman for obtaining technical information and advice, but it is in the application and use of this advice that there comes the acid test. The motto of the Institute, "Science Hand-in-Hand with Labour," must be necessarily applied, or disaster will soon be met with in the many technical problems to be solved. Particularly is this so when introducing additional elements into cast iron or when attempting to reduce the percentage of a constituent already present.

Additions to Cast Iron.

We look upon cast iron as a material containing such a large proportion of other elements than iron that we tend to minimise the importance of small variations in the percentage of the various constituents, with often disastrous results. The problem of making additions to molten cast iron is anything but simple, and cannot be left to the ordinary cupola staff. It is necessary firstly to have available sufficient experience of a cupola and adequate facilities for chemical analysis before you can be confident of obtaining the desired composition at the spout, and then careful mathematical calculations are required and great care necessary to ensure that the additions are uniformly incorporated into the metal. I think that many of the failures we hear of when additions have been made to the ordinary charge are due to the operator's lack of scientific training and knowledge, and his failure to grasp the importance of great care and accuracy during the process.

Probably non-ferrous practice tends to emphasise the importance of the care and accuracy requisite to meet the rigid specifications of the day, and I for one think that the non-ferrous side of foundry work is so fascinating because the composition is more easily controlled, the temperature more readily ascertained, and the variety of alloys available have such varying properties. The development of aluminium alloys is still proceeding apace, and it is probable that from the foundry point of view the use of this metal in various alloys will dominate the industry more and more.

It is at this stage that I wish to pay a tribute to the extraordinary value of the published Proceedings of the Institute of British Foundrymen. I cannot remember a single problem which has arisen in the foundry which has not been, at any rate to some extent, solved by reference to "The Proceedings," and yet it is obvious that this mine of information is not used as it should be, because the index, prepared at considerable expense, of all volumes prior to 1925 has only been bought by members in very limited quantities, and without a suitable index the time involved in searching for the information required is almost prohibitive.

Rationalisation is the topic on the tongue of most of the Branch-Presidents this year, but I think they have failed to lay sufficient stress on the *negative* form of rationalisation now going on, and which by economic pressure is slowly and painfully crushing out of existence the inefficient and ill-equipped foundries up and down the countries. I have heard it stated that in our own country 544 foundries have gone out of existence (a reduction of 19 per cent.), also in North America there are 163 less foundries than there were two years ago, and if I read the statistics given in "The Foundry" correctly there is a reduction of 261 grey-iron foundries in the United States.

Service to Buyers.

I sometimes wonder, does the foundryman ever contemplate John Wanamaker's motto for his own industry. As you know, he was born, bred and worked in a brickyard, but when he died at 84 he employed 17,000 shop assistants in his chain of stores, and the motto insisted on in every store was: "The customer is always right." Think of all those Papers we have read, those pitiful, but eloquent, appeals for more co-operation between the draughtsman and foundryman, the patternmaker and the foundryman—think of all these and then say to yourself: "The customer is always right." I read a few months ago that some of the large stores are perplexed by the abuse of this system, that before a public holiday countless hats, coats, etc., were sent out on approval, and were returned later, obviously used in many cases, with the remark that they were not suitable, and in every case the returns were duly credited. Again, gowns were used as patterns, copied and returned and so on. And yet, in spite of this extraordinary abuse of a policy, it is still found to be a profitable and marvellous example of service.

Admitting that such service may be given too extravagantly, yet cannot the ironfounder take a hint from this and seriously consider whether his service is all that it might be? Service is not only a matter of giving a good quality of castings, though that is, of course, the first essential, but it consists of many more things. Delivery dates are often given with a view to obtaining the order, without careful consideration as to whether it is practicable to keep them, and then, if the order is obtained, the buyer is doomed to disappointment because the time stated is inadequate for the completion of the order. Again, how many of us have any system of advising customers, when, through wasters or other causes, production is delayed, and the delivery dates inevitably postponed? Do those of us who are favoured with running orders on certain parts ever consider whether these parts can be made more economically, and whether this reduction ought not to be passed on to the customer? I suggest that if a firm is going to give real service it will always and promptly advise a customer that in view of certain circumstances and conditions it is possible to reduce the price of certain parts. That sort of service does pay, if conducted honestly, and the firm gradually acquires the confidence of its customer, whilst the firm that goes out for all it can get is sooner or later put into competition, and the unfairness of its prices exposed, with the result that other jobs probably sold at a reasonable price are lost also.

An Injurious Selling System.

And this leads up to the consideration of the *all-round price*, the most injurious of all selling systems to the foundry and the most difficult to eradicate. It is of no use looking to the buyer to alter this, unless he is very enlightened—because it saves him so much time in estimating and in calculations. It is, of course, one of the most misleading ways of estimating, because, obviously, he stands a very good chance of securing all orders which require light or intricate castings, but will certainly lose nearly all the jobs containing heavy or plain castings, and the foundryman who is sufficiently foolish to supply castings on such terms is doomed to obtain an ever-growing proportion of work at unprofitable prices.

Theoretically, every part should have its own

(*Concluded on page* 9.)

Housing the Scientific Institutes.

SIR ARNOLD WILSON AT LONDON FOUNDRYMEN'S DINNER.

The members of the London Branch of the Institute of British Foundrymen, and their many guests, spent an enjoyable evening together on the occasion of the Annual Dinner of the Branch, held at the Holborn Restaurant, London, W.C.2, on Friday, December 19. Mr. A. F. Gibbs (the Branch-President) was in the chair, and the distinguished members and guests present included Mr. F. P. Wilson, J.P. (President of the Institute), Lieut.-Col. Sir Arnold Wilson, K.C.I.E., C.M.G., D.S.O., Principal G. Patchin, A.R.S.M. (Principal of the Sir John Cass Technical Institute), Colonel W. F. Cheesewright, D.S.O., Mr. W. T. Griffiths, M.Sc. (Chairman of the London Section of the Institute of Metals), Mr. Barrington Hooper, O.B.E. (managing director, THE FOUNDRY TRADE JOURNAL), Mr. J. G. Pearce (Director, British Cast Iron Research Association), Mr. J. Cameron, J.P., Mr. V. C. Faulkner and Mr. Wesley Lambert, A.K.C. (Past-Presidents of the Institute), Mr. W. B. Lake (Hon. Treasurer of the Institute), Mr. T. Makemson (General Secretary of the Institute), Mr. A. R. Bartlett and Mr. J. W. Gardom (Past-Presidents of the Branch), Mr. H. G. Sommerfield (Vice-President of the Branch), Mr. Kenneth Bridges, Mr. John Shaw and Mr. A. S. Beech (President of the Foundry Supply & Equipment Association).

A feature of the evening's proceedings was the presentation by Col. Cheesewright (who has been a valued supporter of the Institute and the Branch for many years and has done much to assist the Branch to attain its present flourishing condition) of a silver loving cup. This was received by Mr. H. G. Sommerfield on behalf of the Branch.

The Toasts.

LIEUT.-COLONEL SIR ARNOLD WILSON, K.C.I.E., C.M.G., D.S.O., proposing the toast of "The Institute of British Foundrymen," said he regarded it as a real privilege to be able to do so, one reason being that, when a small boy at school in Rochdale, he had made one of the best friends he had ever made—one named Herbert Strong—who had later become a moulder. By reason of that friendship he had been able to spend some of his spare time watching the work in the moulders' shop, and had learned something of the difference between theory and practice.

The Institute of British Foundrymen, he continued, was a half-way house between the theorists and scientists, on the one hand, and, on the other, the men who had to do the job of work. It was, as Colonel Cheesewright had described it, a vertical section from the top of the industry to the bottom. Probably there had been more purely scientific work done during the past ten years, or at any rate during the past twenty years, than had been done in the previous hundred years in the matter of metals and metallurgy, moulding sands, and the technique and the pure science connected with the industry, but he emphasised that none of it was of any use unless it could be applied, and the application of it rested to a large extent in the hands of men to whose lot it had not fallen to carry out the purely scientific work. The question always was, "Will it work?" There were first the laboratory researches, then the small-scale tests, and finally the actual work in the workshop—and then snags were experienced and good results could not be obtained at once.

Persian and Indian Castings.

Commenting upon the antiquity of the foundry craft, Sir Arnold recalled that during the last few days he had been privileged to see a number of things of extraordinary beauty and rarity which had arrived in this country for the International Exhibition of Persian Art, to be opened at the Royal Academy, Burlington House, London, on January 7, 1931. These included some beautiful bronze statues and statuettes, cast by foundrymen 4,000 years ago with a perfection and beauty which could scarcely be exceeded to-day. By inspecting such things one appreciated the antiquity of the foundrymen's art, and they looked as fresh as they must have looked on the day they were made. Another example of the antiquity of the art was the great iron pillar of Asoka, in India, which he had seen a few years ago. The pillar was 23 ft. long, it weighed a trifle over 6 tons, and it was made of iron so pure that, although it had been exposed to the air for rather more than 2,000 years, it still remained as perfect as when it was made. It had not rusted at all, and the inscription which had been cut into it, apparently with a diamond, some 1,800 years ago, still retained its original freshness.

It was interesting to note that the founding industry was the only industry mentioned in the "Apocrypha" in terms of the warmest and unreserved praise. It was stated in Chapter 37 of the Book of "Ecclesiasticus" that the smith stood at his furnace, watched his job and considered his work; he was always watching the furnace; the fire wasted his flesh; the noise of the hammer and the anvil was always in his ears; his eyes were on the pattern of the thing he sought to make; he made it, and sought to polish it presently. It was also stated that all these men trusted to their hands, and that every one was wise in his work; without them, a city could not be inhabited; they could not go up and down, they could not dwell where they would—there was no such thing as a journeyman moulder—but they would maintain the state of the world; all their desire was in the work of their craft. That, said Sir Arnold, was as good a "chit" as the Institute of British Foundrymen could wish for—and on the best authority.

Reaction to Individualism.

Emphasising the importance of individual efforts, Sir Arnold recalled a remarkable speech made some six months ago, to members of the Brotherhood Movement, by Mr. Stanley Baldwin (late Prime Minister), in which he had expressed the conviction that there would be a reaction from the tendency towards bureaucracy and the general discouragement of private effort, and that there would be openings and opportunities, therefore, for the establishment of voluntary societies to push forward the work of the world in their respective spheres. Sir Arnold said he believed he had noticed during the past two years a very real increase of interest in voluntary societies of the type of the Institute of British Foundrymen, which existed to advance the knowledge and interests of their members, the interests of industry, and, therefore, the interests of the country. He could conceive of no more useful body than one such as this, which existed in order to spread knowledge and to put it into such a form that it was accessible and convenient to all members. It was quite impossible—as he knew, to his cost, for he had something to do with the scientific societies—to read even a small proportion of the mass of scientific information produced, and it was quite impossible to know how much of it one ought to read unless one read it all, because there was no index. Therefore, any society such as this, which could act as a filter and pass on what was really practical to the men who had the responsibility of giving effect to it, was of very special value.

Housing of Technical Institutes.

In this connection Sir Arnold referred to the association whose object it was to bring under one roof the scientific and technical societies connected with mining and metallurgy, chemistry, fuel, oil and rubber—in fact, the heavy industries. He emphasised that it was not intended to amalgamate the various societies concerned into one great society—for that would be as great a mistake as to amalgamate all the unions into one great union, and it would lead us nowhere—but it was desired to house the institutions concerned under one roof, so that those engaged in the various spheres should get to know each other better; for example, the metallurgist would gradually realise that the chemist was not such a bad fellow after all. Each would find, perhaps, that there was more information in the library concerning his own job than he had realised. There was to be a common library, and, above all, a common restaurant to which the members of the constituent bodies could freely resort. Although water was probably the best solvent in chemistry, there was very good reason to believe that alcohol was an even better solvent when applied to the human frame.

The "hear, hear!" which greeted this remark led Sir William to conclude, amid laughter, that perhaps the company would like the opportunity to drink the toast. He proposed it, therefore, and coupled with it the name of Mr. F. P. Wilson, the President.

MR. F. P. WILSON, J.P. (President of the Institute), responding to the toast, first thanked Sir Arnold for the manner in which he had proposed it, and also thanked the London Branch for its hospitality. Indeed, he said that he felt rather under the weight of the hospitality of the branches of the Institute. When elected to the honoured position of President he had hardly realised what he was in for—he needed the verbosity of a Parliamentary candidate and almost the capacity of a City Alderman.

Progress in London.

Recognising that it was a good thing to remind any organisation from time to time of its history and achievements, the President discussed briefly the achievements of the London Branch. In the first place, he pointed out that it was the second largest branch in the Institute. It was, perhaps, natural that the Lancashire Branch should be rather larger numerically, because the area of that Branch was rather more compact and probably contained more foundries than the area of the London Branch. The London Branch had been founded about 19 years ago—some seven years after the foundation of the British Foundrymen's Association, from which the Institute had sprung. The membership of the Branch had grown somewhat slowly during the first ten years, to 135, but from that time onwards it had grown much more rapidly. This period of more rapid growth seemed to have coincided with the period during which the office of Branch Hon. Secretary had been filled by Mr. V. C. Faulkner and Mr. H. G. Sommerfield, and it would be agreed that the Branch owed a great deal to those two gentlemen. During the current session the membership had continued to increase beyond the 255 which was the figure at the time of the Institute's 1930 Convention. A point of considerable interest was that 60 per cent. of the total membership of the Branch comprised full members—a greater percentage than in any other Branch in the country. He recalled that recently the Branch had handed to headquarters a substantial sum from its accumulated funds; that action was very highly appreciated by the National Council of the Institute, and he hoped that the example of the London Branch would be followed by other branches if and when they had any small or large accumulation of funds.

The members of the London Branch were very widely spread. Their area extended northwards

from London to the Midlands, and it extended as far west as Cornwall. It could not be expected, therefore, that all members could attend functions such as this annual dinner, or that they could all attend each meeting, but it was gratifying that foundrymen living at considerable distances were subscribing and benefiting thereby. Another feature was that some 3½ years ago a junior branch had been formed in London. This junior branch was in a flourishing condition, and was unique in that it had a lady chairman (Miss Pittuck). The secretary of the Junior Branch was Mr. J. P. Ellis—the son of one of the Institute's most respected Past-Presidents, Mr. James Ellis, who had passed away recently.

During the present year the membership of the London Branch had increased by 14, and, seeing that the increase in the membership of the Institute as a whole was only 22, the London Branch stood very well. It was to be regretted that the growth of the membership of the Institute seemed to be rather slow, but that apparent slowness was due largely to the fact that there had been erased from the books the names of those who were not paying their subscriptions, for an organisation which carried a heavy burden of that sort could not be regarded as being in a healthy condition. The Branches had done well to weed out the non-payers, who tried to get all the advantages of membership for nothing, and the Institute was better off without them. He believed there was good reason for hoping that the membership would increase steadily.

Obsolete Thinking.

The foundries of the country could not afford to be without the Institute of British Foundrymen. In this connection the President quoted a recent remark made by Major Watson (Chairman of the Yorkshire Branch of the Institution of Mechanical Engineers): "Obsolete minds are more calamitous than obsolete machines, and are far more difficult to transfer to their proper place, the scrap heap." The members of the Institute had grasped the fact that it was essential that their minds should not become obsolete, because obsolescence of the mind would certainly prevent development in the industry, and it was by meeting together socially and for the discussion of their problems that they would prevent that obsolescence which Major Watson deplored. Some people might think that thrills were necessary, and that perhaps The Foundry Trade Journal was not so thrilling as a novel by Edgar Wallace. If they read Eddington and Jeans, or the Annual Report of the British Cast Iron Research Association, however, they would get thrills enough, and would find therein much to think about.

Salesmanship.

Discussing salesmanship, the President pointed out that foundrymen were concerned with it—though perhaps not in the sense that the Prince of Wales had had in mind when he had delivered his notable speech recently to the Sales Managers' Association. A salesman of foundry products did not pack his bag with a motor-car cylinder, or an ingot mould, or even a bath; he could not carry samples as did the man who was selling dress goods, but it was important that he should know something about what he was selling, and should even know something about the cost of it—assuming that his principals knew it. In this connection, he said, that the American costing system, which was the subject of a leader in the Foundry Trade Journal on December 18, deserved very careful study. Emphasising the importance of a proper knowledge of costs, he said that only that evening he had met a friend who had been trying to sell a foundry product for £176, but had been under-bid by £60; he was inclined to think that the lower bidder did not know much about his costs.

One of the dangers arising out of rationalisation, or the merging of a number of firms into one huge organisation, was that of having too many salesmen from one firm worrying one buyer. He had knowledge of cases in which a buyer had been visited on different days by different salesmen selling different things on behalf of the same firm. That indicated that the firm concerned was either very wealthy or badly organised. The big organisations might well consider that point, and study not only the requirements but also the convenience of their customers.

Selling Moulding Machines.

As an example of the importance of studying the convenience of customers, the President quoted an instance in which a certain foundry manager, wishing to inspect some moulding machines at one of the Foundry Trades Exhibitions in London, had arranged to visit the Stands of an English and a foreign exhibitor. Although he had arranged to attend at a given time on a certain day, when he had arrived at the Stand of the English firm he had found that the man who should have been in charge was not there. After a time the man had turned up, but when asked to demonstrate the machine, he expressed his regret that it was not in working order, but it would be working within a few hours. The prospective buyer had gone away in disgust. On arrival at the Stand of the foreign firm, he had found a man awaiting him and everything in readiness for a demonstration of the machine. The demonstration was given, and the firm in question had secured the order. The President did not suggest that the attitude of the British firm he had mentioned was characteristic of British firms generally, but it emphasised the importance of studying the convenience, as well as the requirements, of customers.

Finally, the President expressed his thanks for the reception accorded him.

Individualism.

Mr. J. W. Gardom (Past-President of the London Branch) proposed the toast of "The Visitors," and extended a hearty welcome to them all. In a speech, which was not without its humour, he said that the Branch was particularly anxious to impress its visitors. Its membership was made up of the most go-ahead individuals. Each month they met and discussed, not only their own future, but also the future of allied interests; then, finding they were not recognised, they arranged a dinner and invited to it those whose interests were allied. The visitors were gentlemen who had attained eminence in the professions they represented. In any case, the Branch members benefited greatly by the presence of their visitors, for they learned much from them, and, by reason of that learning, they developed their own individualities. In this connection Mr. Gardom also commented upon the recent appeal by the Prince of Wales for greater individual effort, and said that all must realise how necessary such effort was if this country were to progress. But individuality was being stifled by our ideas of mass production. The real creative and constructive work of the world had been accomplished, and continued to be accomplished, by a relatively small number of people; there were few capable of leadership, the majority being content to follow and ready to obey. Standardisation and uniformity was demanded constantly by our present production methods, and it was the direct opposite of individuality. Our mental surroundings—the wireless, the cinema and the daily Press—all tended to destroy individuality. We lived by custom, habit and repetition, using the same phrases and holding the same opinions. Abraham Lincoln had stated that he had talked with great men, but that he could not see wherein they differed from others. Mr. Gardom held, however, that a comparison of the attributes of our successful men did not reveal any common factor. Successful leaders in every industry could be recognised by some vital quality, which we called "personality" or "individuality." Personality could be acquired by suitable surroundings and by constant effort to get away from the beaten track and to discover new methods and improvements. Sir Isaac Newton, when asked how he had discovered the law of gravitation, had replied: "By constantly thinking about it." We in this country were badly in need of leaders with personality, capable of decisive individual effort—and the Institute of British Foundrymen and other organisations with similar objects, which gave facilities for the presentation of original Papers and the constructive criticism of them, were sowing the seeds of such desirable attributes. On occasions such as this annual dinner the warming influence of the visitors and the mental sunshine which they brought to bear developed and matured those seeds. Another quality which industry badly needed was that of courage.

Finally, Mr. Gardom assured the visitors that at no other function had they been more heartily welcome than at this, and he wished them all success and happiness. He coupled with the toast the name of Mr. W. T. Griffiths.

"Brains" to "Castings."

Mr. W. T. Griffiths, M.Sc. (chairman of the London Local Section of the Institute of Metals), responding, thanked the London Branch of the Institute of British Foundrymen for its hospitality, and, inasmuch as Mr. Gardom had seemed anxious that the visitors should appreciate the Branch, assured him at once that they appreciated it very highly. He, personally, appreciated it particularly, one reason being that this occasion was not the first, or the second, or even the third, on which he had attended the annual dinner of the Branch as its guest.

Discussing the local sections of the Institute of Metals, he said that they had come into being in a rather different way from those of the Institute of British Foundrymen—though they served the same useful purpose. In the past the Institute of Metals had had the reputation of being the means by which very theoretical and abstruse Papers had been presented to the technical members of the community, but it had been felt that the two general meetings which were held by the Institute each year did not provide sufficient opportunities for finding out what those Papers really meant in terms of day-to-day practice. Therefore, it was suggested that the members should meet together more frequently than twice a year in order to discuss the various Papers from a practical point of view. Consequently, the local sections were established, and held their meetings monthly during the winter. That had been one of the most successful moves on the part of the Institute of Metals, and it emphasised the wisdom of the Institute of British Foundrymen in establishing the Branch system earlier. The words on the cover of one volume of the most recent edition of the "Encyclopædia Britannica"—"from 'Brains' to 'Casting'"—reflected very well the purpose of the local sections and branches.

It was true, as Sir Arnold Wilson had said, that a tremendous amount of information was being provided by those who were able to devote their time largely to research and the development of knowledge concerning what was happening inside the products which the men in the foundries had to handle; the gap between the obtaining of that knowledge and the utilisation of it on the foundry floor was quite a wide one, but he believed it was being bridged very satisfactorily by the help of the work done by the branches and sections of the bodies concerned. Commenting upon Sir Arnold's reference to the difficulty of indexing the knowledge available in order that one could pick out the information that one wanted, he said he believed that the indexing system adopted by the Institute of Metals with regard to non-ferrous metals was one of the finest available, and the British Cast Iron Research Association was also doing something useful in that direction. He could speak

feelingly on this problem, for he had made it the subject of his address as chairman of the London Section of the Institute of Metals.

Presentation of the Loving Cup.

COL. W. F. CHEESEWRIGHT, D.S.O., when he rose to present formally the loving cup which he had provided for the London Branch, was received with prolonged applause and with musical honours. It was with the greatest possible pleasure, he said, that he made the presentation, as a token of his very great regard for the members of the London Branch. He recalled that when Mr. Faulkner had first taken over the duties of Editor of THE FOUNDRY TRADE JOURNAL, he had been anxious to promote the social activities of the Branch, and as a result of his suggestions some very cheerful gatherings had been held at Bessemer House—the then headquarters of the "Journal." Col. Cheesewright added that it had been a great pleasure to him to do what he could to make those gatherings a success and to develop social activities generally, and he had no doubt that such activities had resulted in some accession to the membership.

After presenting the cup to Mr. Sommerfield, who received it on behalf of the Branch, Col. Cheesewright filled it with champagne, and it was passed round to the whole gathering.

MR. H. G. SOMMERFIELD (a Vice-President of the Branch) expressed thanks to Col. Cheesewright for having signified in so happy a manner his regard for the London Branch. Mr. Sommerfield recalled with gratitude the occasions, during the years immediately following the war, upon which members of the Branch had visited Bessemer House, where not only had they done good work for the Institute, but had been entertained in a most hospitable manner by Col. Cheesewright, who had been connected with THE FOUNDRY TRADE JOURNAL. In the pioneer work they had been able to do for the Institute and the Branch, it was gratifying to know that they had behind them men with the greatest sympathy towards their aims. Col. Cheesewright had been a source of inspiration to those concerned with the progress of the Institute, and his gift, because it was a reminder of what he had done, would continue to inspire them.

The inscription on the cup was as follows:—

> "Presented to the London Branch of the Institute of British Foundrymen, by Col. W. F. Cheesewright, D.S.O., as a memento of his long association with and interest in the work of the Institute."

A Toast to the London Branch.

PRINCIPAL G. PATCHIN, A.R.S.M. (Principal of the Sir John Cass Technical Institute), proposed the toast of "The London Branch," and coupled with it the name of its President (Mr. A. F. Gibbs). He caused some amusement, in the first place, by his good-humoured complaint that his task, although it was one he felt privileged to perform, had been rendered difficult by reason of the remarks made by previous speakers. He pointed out that Sir Arnold Wilson had said all that need be said about the Institute; "President Wilson" had said all there was to say about the London Branch; and finally, that worthy organ, THE FOUNDRY TRADE JOURNAL, had stated, in its issue of December 4, all there was to know of the Branch-President. What more, therefore, could one say?

A Metallurgical Bias Wanted.

However, inasmuch as salesmanship had been referred to by more than one speaker, he might with advantage play the part of a salesman and expose some of the goods which he personally had for sale. They were called "education"—and he was glad to be able to say that the parent Institute and the London Branch were endeavouring to foster real education in the foundry industry. That was a matter in which he was particularly interested, and he had made considerable effort to foster it in the past few years. At the same time, he was not altogether satisfied that the Institute had made the best bargain in regard to what were called "National Certificates." His personal feeling was that the Certificate had too much of an engineering flavour; it was a certificate rather for the engineer, with a little touch of colour in one corner, which was called "Foundry." By reason of some of the remarks which had been made that evening, he was emboldened to say that in his opinion the basis of foundry work was not engineering, but metallurgy. The very fact that the chairman of the London Section of the Institute of Metals was present was an indication of the important part that metallurgy played. Further, Sir Andrew Wilson had drawn attention to the wonderful new organisation which was to be called "The Association of Scientific and Technical Institutions." It was to be noted that that combination was to include mining, metallurgy and chemistry, but not the institutions of engineers. Surely that was further evidence that the work of the foundry was based on that fundamental science and art which was called metallurgy—and he believed that Sir Arnold was rather flirting with the idea that the Institute of British Foundrymen should be housed within the walls of the contemplated new building. Principal Patchin expressed his own conviction that the metallurgists would always play a very important part in the development of foundry practice. It might be suggested that, because he was a metallurgist, he was biassed and prejudiced, but at any rate it was his experience that, when faults were detected, reference was made in the majority of cases, not to the engineer, but to the metallurgist, for help in locating the cause of those faults.

If the somewhat unpleasant title which had been applied to the foundry industry, *i.e.*, "The Cinderella of the Engineering Industry," was to be removed, there must be developed a sound educational scheme for those associated with foundry work, and it would be his endeavour in the future, as it had been in the past, to do all that he could to promote efficient and valuable education.

It appeared to be the practice, at such gatherings as this, he continued, to quote from the "Apocrypha"; therefore, he quoted the exhortation, "Let us now praise famous men"—for he was coupling with the toast the name of the President of the Branch. He had known MR. Gibbs for many years—first as a student, and latterly as an honoured member of his staff—and felt certain that the enthusiasm and courtesy which he had manifested in education had been manifested also in his activities on behalf of the London Branch of the Institute of British Foundrymen.

The Institute an International One.

The BRANCH-PRESIDENT, who responded in a neat speech of appreciation and thanks, said he did not regard his accession to the presidency of the London Branch as being in the nature of a personal triumph, but as a sure indication of the splendid feeling of comradeship which existed in the Branch. He could not allow this opportunity to pass without expressing his appreciation of the loyalty of the members of the Council and the whole of the rank and file of the Branch during his term of office. Many compliments had been paid to the Branch, and he personally felt that it deserved them all. Commenting on the point which had been made by the President, that 60 per cent. of the membership of the Branch comprised full members, Mr. Gibbs added that the Branch possessed 20 per cent. more full members than did any other Branch of the Institute, its nearest rival being Lancashire. At the same time, he did not think that that was due to the affluence of London members. It was well to remember also that the Branch had members in six foreign countries and in four British Dominions, so that he claimed that, through the Branch, the Institute was becoming an International Institute of Foundrymen. He was proud to know that the membership of the Branch included two Past-Presidents of the Institute, and last, but not least, it was a matter of pride to know that another colleague, Mr. W. B. Lake (a Past-President of the Branch), held one of the most important offices in the Institute, *i.e.*, that of hon. treasurer.

The Branch-President also took the opportunity to express the thanks of the Branch to Mr. Barrington Hooper (managing director of THE FOUNDRY TRADE JOURNAL) for his kindness in providing accommodation at his offices for the holding of the meetings of the Branch Council.

Finally, he expressed thanks for the reception accorded him, and gratitude to Principal Patchin for his encouraging remarks.

An excellent musical entertainment was provided during the evening, which closed with the singing of the National Anthem.

Pure-Iron Electrodes for Welding Cast Iron

A meeting of the Institution of Welding Engineers will be held at the Institution of Mechanical Engineers, Storey's Gate, St. James's Park, London, S.W.1 (by kind permission of the Council of that Institution), on Thursday, January 8, 1931, at 7.45 p.m., when Mr. H. D. Lloyd and Mr. J. S. G. Primrose will read a Paper entitled "The Use of Pure-Iron Electrodes for Welding Cast Iron." The Paper will be illustrated by lantern slides, and will be followed by a discussion. Members of other engineering and metallurgical institutions are cordially invited to attend the above meeting.

Refractories Association of Great Britain.

The 7th annual Refractories Ball will be held on Friday, January 16, 1931, at the Royal Victoria Hotel, Sheffield. Dinner will be served in the ballroom, and tables are being reserved in strict rotation of applications received. Applications must be made before January 10, 1931, and may be sent to the Secretary, Mr. W. J. Rees, F.I.C., B.Sc.Tech., Refractories Department, The University, St. George's Square, Sheffield. The tickets are one guinea each, exclusive of wines.

Foundries—and Foundries.

(*Concluded from page* 6.)

selling price, based on the labour and material cost, and if this is impracticable, as far as possible, sets of castings should have their own selling price and every foundryman should be in a position to say what it really costs to produce any of his castings.

I am afraid that this address reads rather like a sermon. It is not in the least the address I really intended to give when I suggested the title of my Paper, and since I have written it I have noticed that it covers much of the ground covered by Mr. H. Sayers in his presidential address to the West Riding Branch last month, and I feel that though, perhaps, it is not strictly the type of Paper one looks for at a technical gathering of this kind, yet it covers some of the vital questions that our industry is faced with in these critical times, and, my final words are these, away with this Cinderella myth. We can conquer all our difficulties. Let us with mutual help and co-operation commence to press forward.

XUM

Fabrication of Acid-Resisting Steels.

NOTES ON MODERN PRACTICE.

At a meeting of the Institution of Welding Engineers held in London on December 11, MR. C. CYRIL HALL read a Paper on "The Fabrication of Plant in Acid-Resisting Steels," in the course of which, in connection with the welding of these steels, he pointed out that, with the exception of hammer or smith's hearth-welding and the carbon-arc process, all the other systems of welding were in use in connection with the austenitic steels. (The author specifically dealt with the "18 and 8" chrome-nickel steel.) The electric-resistance types of welding, as exemplified by the spot, seam and flash processes, did not present any great difficulties. As with other metals, cleanliness of the parts to be welded was essential. A somewhat closer temperature control than for mild steel was usually necessary. For butt welding of the thicker sections, the flash process was found generally to be superior to the plain resistance-butt process.

Both the gas and electric-arc processes (continued the author) have their particular field of usefulness. As a general rule it can be taken that the oxy-acetylene process is satisfactory for thicknesses up to $\frac{1}{8}$ in. The arc process can be used for 14 g. ($\frac{5}{64}$ in.) and thicker. These are purely arbitrary limits and may be modified as circumstances demand. As a matter of fact, quite successful arc welding has been done on 20 g. (0.036 in.) thick material, but a specially-designed plant, with close control, is usually necessary for this work. On the other hand, with the oxy-acetylene process, it is difficult to ensure a really satisfactory weld on thick material.

High Standard of Welding Necessary.

A higher standard of welding is necessary with special steels than is required for ordinary steels. The main requirement in the case of a mild-steel weld is mechanical strength, probably coupled with water tightness. In the case of a weld in these special steels, however, the following conditions must be met:—(1) Mechanical strength; (2) soundness, *i.e.*, freedom from porosity; (3) maintenance of correct composition.

Condition (1) requires no elaboration. With regard to (2), any imperfections on a weld, such as blowholes, etc., are potential seats for corrosion, and may form a lodgment for foreign matter which, in some chemical and food processes, may be a serious factor. In connection with (3), it will be obvious that the particular characteristics of these steels are due primarily to their composition, and if the same characteristics are to be obtained in the weld, the composition of the metal in the weld must be the same as that of the parent metal. In this respect the electric-arc process is preferable to the oxy-acetylene process, as it is now more foolproof. Owing to the high temperature of the arc, some loss of chromium, and to a much less extent of nickel, is likely to occur by oxidation. When using an electrode with a wire core having the normal composition of the steel, welds have been found upon analysis to have lost from 2 per cent. to 3 per cent. of chromium. This factor, however, is now compensated for in the electrodes produced by the two main electrode makers catering for this field.

Another advantage of the electric-arc process is that difficulties, due to distortion, are usually less pronounced than when the gas system is used, as the heating effect with the arc process is much more local. This also results in less residual internal stress being left in the welded structure.

Heat Distribution.

All welding processes must inevitably result in an area of the parent metal adjacent to the weld being subjected to the undesirable heating range already mentioned, *i.e.*, on each side of a weld, between the metal which has been molten and the metal which has remained cold there must be an area which has attained temperatures from 500 deg. C. to 900 deg. C. Bearing in mind what was said earlier, namely, that the undesirable change brought about in these steels is a function of both time and temperature, it will be readily understood that as the steel is heated for a shorter period of time with the electric-arc process than with the gas process, the former system is to be preferred on this account.

The actual welding operation by the arc process presents little or no difficulty when the proper electrodes are used. As in the case when welding other steels, as short an arc as possible should be used. Direct current is generally preferred to alternating current, although much very successful welding has been done with alternating current. When using direct current, many welders prefer to reverse the polarity, *i.e.*, to make the electrode the positive pole and to connect the work to the negative pole. With the proper type of electrode it is usually found that an intelligent welder is very quickly able to produce excellent welds in these steels by the arc process.

Preparation of Plates.

With regard to the preparation of the plates for welding, a similar practice to that employed for mild steel can be adopted. Chamfering of the edges is generally not considered necessary up to $\frac{1}{8}$ in. thick, but a gap should be left between the edges to ensure proper penetration. This factor of penetration is very important. One has occasionally come across plants, the regulation of which was not sufficiently sensitive, inasmuch as when using one "stop," the penetration was not quite good enough, whereas the next "stop" proved to give much too drastic an arc. In modern plants, however, this difficulty does not exist.

When arc-welding special steels it is a good policy to lay down light, rather than heavy, runs. In other words, "puddling" of the metal during welding should not be done. As a matter of fact, the welding operation should be carried out as quickly as possible, consistent with soundness of deposit and adequacy of penetration. Greater care than usual is necessary in removing the slag left by the first layer before depositing the second layer.

In all welding operations it is very necessary to bear in mind that these steels have a considerably greater coefficient of expansion than mild steel, *i.e.*, about 50 per cent. greater. Stresses set up by welding are, therefore, very much more than in the case of similar structures in mild steel, and unsatisfactory welds will sometimes fail from this cause. It is incumbent upon both the designer and the welder to take this expansion factor into account. The welding of already highly-stressed metal should be avoided where possible, as should also the welding together of widely dissimilar thicknesses or sections. Heat-treatment after welding will serve to remove the high stresses which may be left in a structure as a result of welding operations. The proper use of the oxy-acetylene process calls for more care and skill.

Deposited Carbon.

The presence of increased carbon in the weld is detrimental from several points of view. In the first place the high carbon renders the weld hard, and this is accompanied by a corresponding reduction in ductility. Such a weld, therefore, tends to be brittle. The more serious aspect of carbon increment, however, is that, in certain circumstances, the response of the steel to corrosive media may have been modified. A further trouble arising from carbon pick-up during welding shows itself when polishing operations are necessary. In frames for showcases and similar purposes, if an excess of carbon has been used during welding, it will be found that the welded joint does not assume the same polished appearance as the parent metal adjacent to it, but appears "cloudy" or "milky." It will be seen, therefore, that the maintenance of a strictly neutral flame should be the first concern of every welder dealing with these special steels. A check on the type of flame which has been used is usually provided by the appearance of the deposited metal after welding. Brightness in a finished weld is usually a danger sign, and shows that a reducing flame has been used.

Condition of Molten Metal.

The tip of the welding cone should always be in contact with the pool of molten metal. This class of steel does not like the large outer envelope of the blowpipe flame. This factor can be very clearly demonstrated by holding a piece of wire of this material in the large outer zone of the flame. Part of this zone of the flame has a sufficiently high temperature to melt the wire, but it will be found that the wire does not melt cleanly but oxidises or "shrivels up." If, however, the wire is held in the tip of the true welding cone, a perfectly clean melt will result. It is, therefore, necessary that the tip of the cone be in contact with the metal if the best results are to be obtained. This applies, of course, not only to the material being welded but also to the feeding rod or wire. The best practice when adding wire is to use a wire of such a gauge that will enable feeding to be continuous, thus allowing the tip of the wire to be kept constantly at the tip of the flame. In those cases where it is the welder's practice to feed intermittently, the feeding wire should not be allowed to remain just outside the true welding cone, *i.e.*, in the outer envelope, but should be completely withdrawn from the outer zone of the flame and fed in again to the correct spot as and when required. If the wire is not completely withdrawn, it will be found that, upon attempting to feed, the wire will not melt properly but will form an annoying oxide on the surface of the molten metal. The molten metal should never become so hot as to boil. A clear, tranquil pool should always be obtained. Much of the welder's trouble in the early stages of welding these special steels is traceable to overheating.

The best way to ensure adequate penetration when welding these steels is to leave a small gap between the edges being welded and allow the feeding wire to penetrate through and fill the gap. It is very difficult to obtain proper penetration if the edges of the sheets are butted close together. In such cases the best procedure is to allow the tip of the welding cone to pierce the joint, thus making a hole which can be progressively filled in with the feed wire. It is understood, of course, that the feed wire is always of the same composition as the steel which is being welded. It is worthy of note that no elements are lost by oxidation with the oxy-acetylene process.

On account of the necessity for ensuring clean, sound welds, the edges of all plates or parts being welded should be cleaned free from oxide before welding. In the case of descaled plates as received from the works, no further cleaning is necessary. Before welding the second side of a joint, the oxide resulting from the first weld should be removed as much as possible by chipping, grinding or scratch-brushing. It has already been pointed out in connection with electric-arc welding that the expansion factor of these special steels is about 50 per cent. greater than that of mild steel. The results of this are usually more apparent in the oxy-acetylene process than in the arc process, on account of the larger area of metal heated by the gas process.

Good Luck

and

Success

in

1931

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and

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Iron and Steel Markets.

Pig-Iron.

MIDDLESBROUGH.—With many of the consuming works on the North-East Coast standing idle for practically a fortnight owing to Christmas and New Year holidays, business in Cleveland iron has been virtually in abeyance, and very few orders have been booked during the vacation. In the meantime, nearly the whole of the output of the blast furnaces for a week or more will have to go into stock, thus further increasing already substantial accumulations. The question of the liquidation of these surplus stocks is one of considerable moment to consumers as well as to holders. At the moment, few, if any, pig-iron producers are in a position financially strong enough to carry heavy stocks for an indefinite period, and there certainly seems little prospect of all this iron being sold at current prices On the other hand, Cleveland consumers can buy both Midland and Continental iron at delivered prices well below the local fixed quotations. All this strengthens the growing conviction that the Cleveland ironmasters will not be able to resist the pressure much longer. Not improbably, prices will be reviewed early next month. But for the present, at all events, prices are unchanged, quotations ruling thus:—No. 3 Cleveland G.M.B., 63s. 6d.; No. 1 foundry iron, 66s.; No 4 foundry, 62s. 6d.; No. 4 forge, 62s. per ton.

There has naturally been a decreased demand in the market for East Coast hematite, and prices have temporarily eased to 70s., with No. 1 quality at 70s. 6d. per ton. But it is doubtful if these figures would be accepted for forward delivery. There is a feeling that costs have touched bottom, and makers, encouraged by a more healthy forward inquiry, are inclined to ask higher prices for deliveries over the first quarter of 1931, for which period some good orders are in the market. On the North-West Coast, Bessemer mixed numbers are quoted at 70s. per ton at works.

LANCASHIRE.—A slight improvement in the condition of the textile industry inspires some hope of an early revival of demand by machinery makers, and consequently a better outlook for the foundry trade in this area. At the present time there is virtually no new business passing in the foundry-iron market, and, with most users bought over the first month of the year, little fresh activity is looked for until the price position is clear at the end of January. For the time being, the range of prices is 69s. 6d. for No. 3 Derbyshire and Staffordshire, 68s. for Northamptonshire, and from 90s. 6d. to 91s. for Scottish No. 3, all per ton delivered local stations.

THE MIDLANDS.—Owing to the prevailing holiday conditions, very few orders for foundry pig have been recently placed in the Birmingham area. Some consumers consider that business will expand to some extent after the turn of the year; many, on the other hand, believe that it will be well into the first quarter of 1931 before any improvement takes place. Meanwhile the minimum rates are quoted by the furnaces, namely, 67s. 6d. for No. 3 Northants and 71s. for Derbyshire and Staffordshire No. 3, these figures including delivery to local stations.

SCOTLAND.—The current week having coincided with the Scottish New Year festival celebrations, business has been practically non-existent in pig-iron markets. No change, however, has taken place in prices, which remain firm at 76s. 6d. per ton for No. 3 foundry iron, with the addition of 2s. 6d. per ton for No. 1 quality.

Finished Iron.

In Birmingham and the district, the ironworks were closed for the whole of last week, and some of them will extend the holidays beyond this period, in view of the scarcity of work. Unfortunately, there are no signs whatever of any improvement at an early date. It is only in connection with marked bars that there is any activity, and even in this case business has fallen away to some extent during the last few weeks. Recent prices are maintained. They are £12 10s. at works for marked bars and £9 15s. to £10 5s. for crown iron. The current price for nut and bolt iron from local mills is £8 15s. to £9, but only spasmodic orders are being placed, as the bulk of the Black Country's requirements are being obtained from the foreign mills, whose figures range from £5 5s. to £5 7s. 6d. delivered works.

Steel.

At Sheffield this week, the steel market is quiet and without any feature. At several of the Sheffield works the Christmas holidays will be rather longer than is customary, but at most the vacation will be only of the usual length. The Continental market for semis shows no particular movement. Prices on the whole are a little easier than they were a few weeks back, but producers are maintaining a firm front, and many of them are still entirely off the market. A considerable tonnage of foreign semis, however, was bought during the recent period of rising prices, and heavy deliveries into this country must be expected for some time to come. The home makers have made no change in their prices. The tone of the tinplate market is again easier, with coke quality quoted on the basis of 15s. 9d., net cash, f.o.b. South Wales ports.

Scrap.

Although business in foundry scrap material on Tees-side has been almost completely suspended, a more hopeful feeling persists. There is a firm conviction that prices have touched bottom, and it would not need much encouragement to revive demand. Prices meantime remain thus:—Ordinary heavy cast iron 50s., and machinery quality in handy sizes 52s. 6d. In the Midlands, there is still a limited demand for cast-iron scrap, and for the heavier qualities a better price, comparatively speaking, is obtained than for any other quality. Heavy machinery cast-iron scrap is offered at 60s. delivered, and ordinary heavy metal at 55s. to 57s. 6d., with light cast-iron scrap weak at 45s. delivered. In Scotland, quotations for all classes of cast-iron scrap continue to fall. First-quality machinery cast-iron scrap, suitable for foundries, is at 55s., with ordinary cast iron to the same specification at 51s. 3d. to 52s. 6d., cast-iron railway chairs 55s., light metal 40s., and furnace firebars at 37s. 6d. The above prices are all per ton delivered f.o.t. consumers' works.

Metals.

Copper.—In last week's market for base metals an outstanding feature was the steady increase in the volume of turnover, nearly 6,000 tons, while quotations showed a further advancing tendency. A further reduction of 50 points was made by the Copper Exporters in their price, which, accordingly, came down to 10.30 cents c.i.f., or £47 11s. 3d. c.i.f. United Kingdom ports, while there has been a certain amount of spasmodic offering by second hands at 9.75 cents, such quotations, however, not being available for shipment.

Closing quotations :—

Cash.—December 23, £46 5s. to £46 7s. 6d.; December 24, £46 10s. to £46 12s. 6d.; December 29, £47 12s. 6d. to £47 13s. 9d.; December 30, £46 15s. to £46 17s. 6d.; December 31, £46 8s. 9d. to £46 10s.

Three Months.—December 23, £46 to £46 2s. 6d.; December 24, £46 6s. 3d. to £46 8s. 9d.; December 29, £47 7s. 6d. to £47 8s. 9d.; December 30, £46 10s. to £46 12s. 6d.; December 31, £46 8s. 9d. to £46 10s.

Tin.—The uncertainty as to the action to be taken by the Producers' Association, of which many rumours have been in circulation of late, has now been dispelled by the announcement issued to the Press for publication at the week-end. From this it would appear that plans to limit the export of tin from certain countries after December 31, under a quota system, are being considered by the Governments of the Federated Malay States, the Dutch East Indies, Bolivia and Nigeria. The system will embrace virtually 90 per cent. of the world output, and will be in force for two years. The quota represents the maximum tonnages which may be exported by the various countries after January 1.

Official closing prices :—

Cash.—December 23, £111 to £111 2s. 6d.; December 24, £115 15s. to £116; December 29, £117 5s. to £117 7s. 6d.; December 30, £118 to £118 2s. 6d.; December 31, £116 10s. to £116 12s. 6d.

Three Months.—December 23, £112 7s. 6d. to £112 10s.; December 24, £117 to £117 5s.; December 29, £118 12s. 6d. to £118 17s. 6d.; December 30, £119 10s. to £119 12s. 6d.; December 31, £118 to £118 2s. 6d.

Spelter.—The turnover of late in the market has been about up to average at 3,000 tons, and on balance values showed a slight improvement, immediate shipment closing at £13 15s. and March at about 8s. 6d. more. At one time the quotation dropped to £13 3s. 9d., the lowest point ever recorded, but from that low level there was some improvement, due more to the development of a better tone in other metals than to any keen demand from buyers, who in many cases have already covered well into 1931 at rather higher prices.

Daily fluctuations :—

Ordinary.—December 23, £13.15s.; December 24, £13 15s.; December 29, £13 12s. 6d.; December 30, £13 15s.; December 31, £13 15s.

Lead.—The turnover recently was higher than usual at 3,300 tons, but selling pressure was in evidence and values lost ground on balance, the close being £15 for prompt shipment. This, however, was by no means the lowest point reached, for December at one time was done at £14 10s. Even at this low level there does not seem to be a great deal of confidence in lead, and it would not be surprising to see the quotation fall even lower.

The week's prices have been :—

Soft Foreign (Prompt).—December 23, £15 3s. 9d.; December 24, £15 3s. 9d.; December 29, £15 1s. 3d.; December 30, £15 2s. 6d.; December 31, £15.

Cement Joints for cast-iron tanks, etc., can be made with four parts of sand and one of cement. Too large a proportion of sand greatly weakens the joint. In the case of tanks, extreme care should be taken in ramming the mixing well behind every bolt, or there is a likelihood of leaks and sweating of the joint.

CAST IRON FLANGED PIPES
2 in.—12 in. & CONNECTIONS. to 24 in. dia.
WE HAVE FIFTY-TWO YEARS OF ACCUMULATED EXPERIENCE AND METAL PATTERNS.
JAMES & RONALD RITCHIE, LTD.,
Telephone: 3852 (2 Lines). MIDDLESBROUGH. Telegrams: "Ritchie, Middlesbrough."

Special CARBON BLACKING

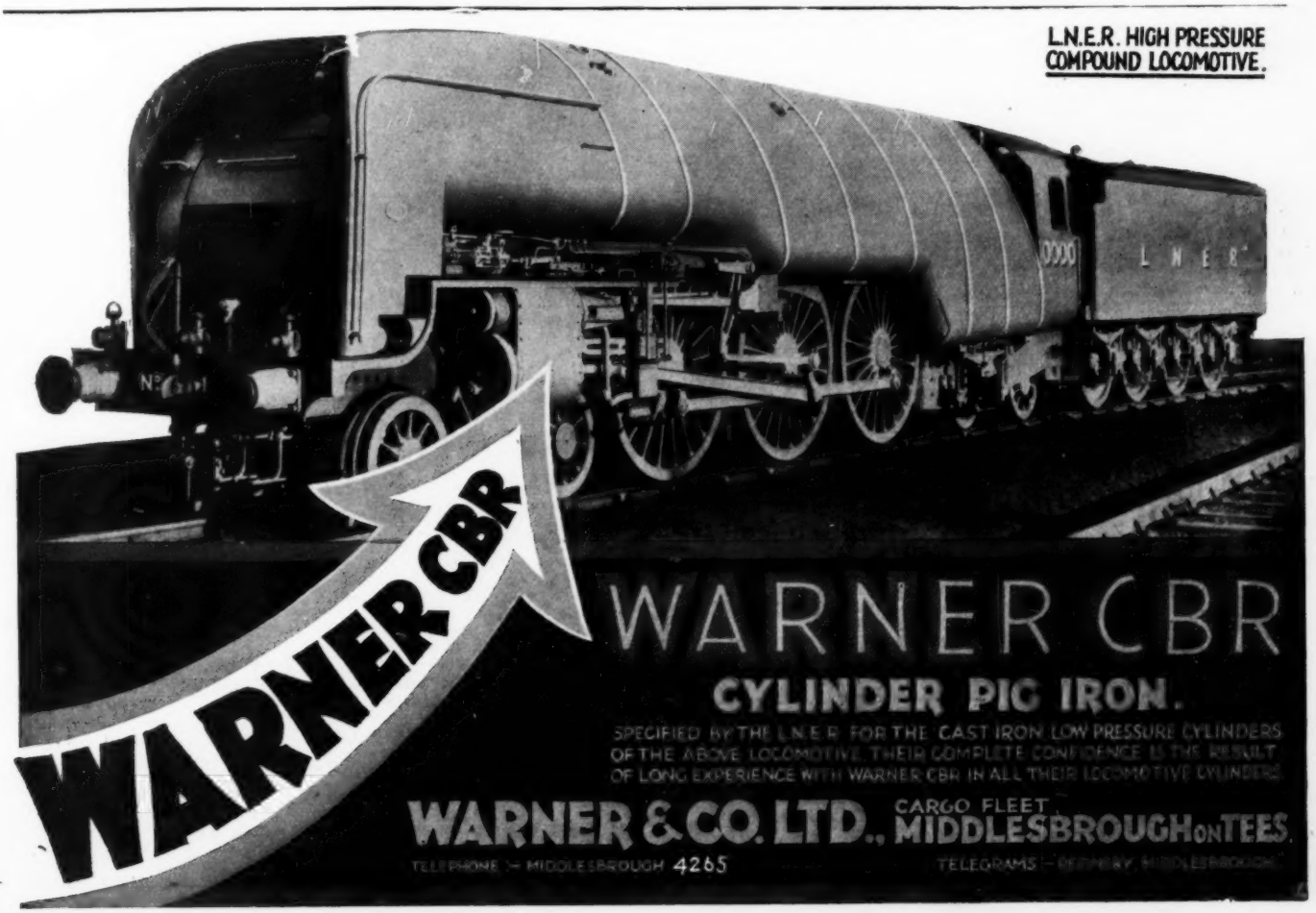
PLUMBAGO
CORE GUM
WHITE DUST
COAL DUST
REQUISITES

67 MADE BY A FIRM WITH YEARS EXPERIENCE.

JAS. DURRANS & SONS LIMITED.
PHŒNIX WORKS, PENISTONE, NR. SHEFFIELD.

Also—
GANISTER.
LOAM AND SAND MILLS.
STUDS,
CHAPLETS,
BRUSHES,
CORE ROPES,
BUCKETS,
SPADES, Etc.
LADLES,
FIRE BRICKS,
STONE FLUX.
CASTING CLEANERS,
PIPE NAILS,
SPRIGS,
WIRE BRUSHES,
BELLOWS.

L.N.E.R. HIGH PRESSURE COMPOUND LOCOMOTIVE.



WARNER CBR

WARNER CBR
CYLINDER PIG IRON.
SPECIFIED BY THE L.N.E.R. FOR THE CAST IRON LOW PRESSURE CYLINDERS OF THE ABOVE LOCOMOTIVE. THEIR COMPLETE CONFIDENCE IS THE RESULT OF LONG EXPERIENCE WITH WARNER CBR IN ALL THEIR LOCOMOTIVE CYLINDERS.

WARNER & CO. LTD., CARGO FLEET, MIDDLESBROUGH ON TEES.
TELEPHONE — MIDDLESBROUGH 4265
TELEGRAMS — REFINERY, MIDDLESBROUGH

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash	46	8	9
Three months	46	8	9
Electrolytic	49	10	0
Tough	47	15	0
Best selected	48	5	0
Sheets	77	0	0
India	60	5	0
Wire bars	49	17	6
Do. March	49	17	6
Do. April	49	17	6
Ingot bars	49	17	6
H.C. wire rods	51	0	0
Off. av. cash, November	46	3	8¼
Do., 3 mths. November	46	3	10½
Do., Sttlmnt., November	46	3	1½
Do., Electro, November	49	10	3
Do., B.S., November	48	1	10½
Do., wire bars, November	50	1	3

Solid drawn tubes 11¼d.
Brazed tubes 11¼d.
Wire 7¼d.

BRASS.

Solid drawn tubes 10d.
Brazed tubes 12d.
Rods, drawn 9¾d.
Rods, extd. or rlld. 5¾d.
Sheets to 10 w.g. 8¼d.
Wire 8¾d.
Rolled metal 7¾d.
Yellow metal rods 5¾d.
Do. 4 × 4 Squares 6¼d.
Do. 4 × 3 Sheets 6¾d.

TIN.

	£	s.	d.
Standard cash	116	10	0
Three months	118	0	0
English	118	0	0
Bars	120	2	6
Straits	120	0	0
Australian	117	10	0
Eastern	122	15	0
Banca	121	0	0
Off. av. cash, November	113	11	10½
Do., 3 mths., November	114	18	3½
Do., Sttlmt., November	113	11	3

SPELTER.

	£	s.	d.
Ordinary	13	15	0
Remelted	12	7	6
Hard	10	17	6
Electro 99.9	15	17	6
English	13	2	6
India	12	0	0
Zinc dust	20	0	0
Zinc ashes	3	5	0
Off. aver., November	14	19	5¼
Aver., spot, November	14	14	1½

LEAD.

	£	s.	d.
Soft foreign ppt.	15	0	0
English	16	5	0
Off. average, November	15	18	7⅞
Average spot, November	15	18	8½

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	22	0	0
Do. V.M. ex-whf.	24	0	0
Rods	26	10	0
Boiler plates	19	0	0
Battery plates	19	15	0

ANTIMONY.

	£	s.	d.
Special brand, Eng.	36	0	0
Chinese	25	0	0
Crude	22	0	0

QUICKSILVER.

Quicksilver £22 7 6

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—
25% £7 17 6
45/50% £11 10 0
75% £18 10 0
Ferro-vanadium—
35/50% 12/8 lb. Va.
Ferro-molybdenum—
70/75% c. free 4/2 lb. Mo.
Ferro-titanium—
23/25% carbon-free 10d. lb.
Ferro-phosphorus, 20/25% £15 17 6
Ferro-tungsten—
80/85% 2/3 lb.
Tungsten metal powder—
98/99% 2/6 lb.
Ferro-chrome—
2/4% car. £30 10 0
4/6% car. £23 5 0
6/8% car. £22 10 0
8/10% car. £22 2 6
Ferro-chrome—
Max. 2% car. £32 17 6
Max. 1% car. £37 15 0
Max. 0.70% car. £41 0 0
70% carbon-free 10d. lb.
Nickel—99% cubes, or pellets £170 0 0
Ferro-cobalt 9/6 lb.
Aluminium 98/99% £85 0 0
Metallic chromium—
96/98% 2/7 lb.
Ferro-manganese (net)—
76/80% loose £11 0 0 to £11 15 0
76/80% packed £12 0 0 to £12 15 0
76/80% export £11 0 0 to £11 10 0
Metallic manganese—
94/96% carbonless 1/4 lb.
Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten £0 2 2
Finished bars, 18% tungsten £0 3 0
Per lb. net, d/d buyers' works.
Extras—
Rounds and squares, 3 in. and over 4d. lb.
Rounds and squares, under ½ in. to ¼ in. 3d. lb.
Do., under ¼ in. to $\frac{3}{16}$ in. 1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ¾ in. 3d. lb.
Do., under ½ in. × ¼ in. 1/- lb.
Bevels of approved sizes and sections 6d. lb.
Bars cut to length, 10% extra.

SCRAP.

South Wales—	£	s.	d.	£	s.	d.
Heavy steel				2	5	0
Bundled steel and shrngs.				1	15	0
Mixed iron and steel	1	17	6 to	2	0	0
Heavy cast iron	2	5	0 to	2	7	6
Good machinery for foundries				2	7	6

Cleveland—						
Heavy steel				2	6	0
Steel turnings				1	15	0
Cast-iron borings				1	10	0
Heavy forge				3	2	6
W.I. piling scrap				2	17	6
Cast-iron scrap	2	10	0 to	2	12	6

Midlands—						
Light cast-iron scrap				2	5	0
Heavy wrought				3	2	6
Steel turnings					—	

Scotland—						
Heavy steel				2	7	6
Ordinary cast iron				2	11	3
Engineers' turnings				1	12	6
Cast-iron borings				1	15	0
Wrought-iron piling				2	18	6
Heavy machinery				2	15	0

London—Merchants' buying prices delivered yard.

Copper (clean)	37	0	0
Brass	29	0	0
Lead (less usual draft)	13	0	0
Tea lead	9	10	0
Zinc	7	0	0
New aluminium cuttings	50	0	0
Braziery copper	34	0	0
Gunmetal	36	0	0
Hollow pewter	76	0	0
Shaped black pewter	56	0	0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast—
Foundry No. 1 66/-
Foundry No. 3 63/6
Foundry No. 4 62/6
Forge No. 4 62/-
Hematite No. 1 70/6
Hematite M/Nos. 70/-

N.W. Coast—
Hem. M/Nos. d/d Glas. 78/-
„ d/d Birm. 88/6

Midlands—
Staffs. common* —
„ No. 4 forge* 66/-
„ No. 3 fdry.* 71/-
Shrops. basic —
„ Cold blast, ord. —
„ „ roll iron —
Northants forge* 62/6
„ fdry. No. 3* 67/6
Derbyshire forge* 66/-
„ fdry. No. 3* 71/-
„ basic* —
*d/d Black Country dist.

Scotland—
Foundry No. 1 79/-
„ No. 3 76/6
Hem. M/Nos. 76/-

Sheffield (d/d district)—
Derby forge 61/-
„ fdry. No. 3 66/-
Lincs. forge —
„ fdry. No. 3 66/-
E.C. hematite 82/6
W.C. hematite 86/6

Lincs. (at furnaces)—
Forge No. 4 —
Foundry No. 3 —
Basic —

Lancashire (d/d eq. Man.)—
Derby forge 64/6
„ fdry. No. 3 69/6
Staffs foundry No. 3 69/6
Dalzell, No. 3 (special) 105/- to 107/6
Summerlee, No. 3 90/6 to 91/-
Glengarnock, No. 3 —
Eglinton, No. 3 90/6 to 91/-
Gartsherrie, No. 3 90/6 to 91/-
Monkland, No. 3 90/6 to 91/-
Shotts, No. 3 90/6 to 91/-

FINISHED IRON AND STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£	s.	d.	£	s.	d.
Bars (cr.)	10	0	0 to	10	15	0
Nut and bolt iron	8	15	0 to	9	0	0
Hoops	10	15	0 to	12	0	0
Marked bars (Staffs) f.o.t.				12	10	0
Gas strip	10	15	0 to	12	0	0
Bolts and nuts, ½ in. × 4 in.				14	5	0

Steel—						
Ship plates	8	15	0 to	8	17	6
Boiler plts.	9	7	6 to	10	5	0
Chequer plts.				10	12	6
Angles				8	7	6
Tees				9	7	6
Joists				8	10	0
Rounds and squares, 3 in. to 5½ in.				9	7	6
Rounds under 3 in. to ½ in. (Untested)				7	12	6
				and upwards		
Flats—8 in. wide and over				8	12	6
„ under 8 in. and over 5 in.				8	17	6
Rails, heavy				8	10	0
Fishplates				12	0	0
Hoops (Staffs)	9	5	0 to	9	10	0
Black sheets, 24g.	8	12	6 to	9	12	6
Galv. cor. shts., 24g.				11	5	0
Galv. fencing wire, 8g. plain				12	0	0
Billets, soft	5	12	6 to	6	5	0
Billets, hard	7	10	0 & up.			
Sheet bars	5	0	0 to	5	12	6
Tin bars	5	0	0 to	5	12	6

PHOSPHOR BRONZE.

Per lb. basis.

Strip	1/0½
Sheet to 10 w.g.	1/0¾
Wire	1/1½
Rods	1/0¾
Tubes	1/5½
Castings	1/0½

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. CLIFFORD & SON, LIMITED.

NICKEL SILVER, &c.

	per lb.
Ingots for raising	8d. to 1/2
Rolled—	
To 9 in. wide	1/2 to 1/8
To 12 in. wide	1/2½ to 1/8½
To 15 in. wide	1/2½ to 1/8½
To 18 in. wide	1/3 to 1/9
To 21 in. wide	1/3½ to 1/9½
To 25 in. wide	1/4 to 1/10
Ingots for spoons and forks	8d. to 1/4½
Ingots rolled to spoon size	11d. to 1/7½
Wire round—	
3/0 to 10 G.	1/5½ to 2/0½

with extras according to gauge.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	17.76
No. 2 foundry, Valley	17.00
No. 2 foundry, Birm.	14.00
Basic	18.76
Bessemer	19.26
Malleable	19.26
Grey forge	18.26
Ferro-mang. 80%	94.00
O.-h. rails, h'y, at mill	43.00
Billets	31.00
Sheet bars	31.00
Wire rods	36.00
	Cents.
Iron bars, Phila.	2.09
Steel bars	1.60
Tank plates	1.60
Beams, etc.	1.60
Skelp, grooved steel	1.60
Skelp, sheared steel	1.60
Steel hoops	1.90
Sheets, black, No. 24	2.35
Sheets, galv., No. 24	2.90
Sheets, blue an'l'd, No. 13	2.05
Wire nails	1.90
Plain wire	2.30
Barbed wire, galv.	2.55
Tinplates, 100-lb. box	$5.00

COKE (at ovens).

Welsh foundry	25/- to 27/6
„ furnace	16/- to 18/-
Durham and Northumberland—	
„ foundry	15/- to 15/6
„ furnace	14/6
Midlands, foundry	—
„ furnace	—

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 box	15/9
„	28×20 „	31/6
„	20×10 „	23/-
„	18½×14 „	16/6
C.W.	20×14 „	15/-
„	28×20 „	29/6
„	20×10 „	21/-
„	18½×14 „	16/-
Terneplates	28×20	31/- per box basis f.o.b.

SWEDISH CHARCOAL IRON & STEEL.

Pig-iron	£6	0	0 to	£7	10	0
Bars, hammered, basis	£17	10	0 to	£18	10	0
Bars and nail-rods, rolled, basis	£15	17	6 to	£16	15	0
Blooms	£10	0	0 to	£12	0	0
Keg steel	£32	0	0 to	£33	0	0
Faggot steel	£20	0	0 to	£24	0	0
Bars and rods dead soft, steel	£11	0	0 to	£14	0	0

All per English ton, f.o.b. Gothenburg.

TUBES AND FITTINGS.

Over ½ in. up to 6 in.

	Tubes.	*Fittings.*
Gas	62½%	47½%
Water ..	58½%	42½%
Steam ..	55%	37½%

W.I. 12½% extra.

DAILY FLUCTUATIONS.

Standard Copper (cash).

		£	s.	d.	
Dec.	23 ..	46	5	0	dec. 20/-
,,	24 ..	46	10	0	inc. 5/-
,,	29 ..	47	12	6	,, 22/6
,,	30 ..	46	15	0	dec. 17/6
,,	31 ..	46	8	9	,, 6/3

Electrolytic Copper.

		£	s.	d.	
Dec.	23 ..	48	15	0	dec. 5/-
,,	24 ..	49	5	0	inc. 10/-
,,	29 ..	50	10	0	,, 25/-
,,	30 ..	49	10	0	dec. 20/-
,,	31 ..	49	10	0	No change

Standard Tin (cash).

		£	s.	d.	
Dec.	23 ..	111	0	0	dec. 62/6
,,	24 ..	115	15	0	inc. 95/-
,,	29 ..	117	5	0	,, 30/-
,,	30 ..	118	0	0	,, 15/-
,,	31 ..	116	10	0	dec. 30/-

Tin (English Ingots).

		£	s.	d.	
Dec.	23 ..	112	2	6	dec. 67/6
,,	24 ..	117	0	0	inc. 97/6
,,	29 ..	118	7	6	,, 27/6
,,	30 ..	119	2	6	,, 15/-
,,	31 ..	118	0	0	dec. 22/6

Zinc Sheets (English).

		£	s.	d.	
Dec.	23 ..	23	0	0	No change
,,	24 ..	22	0	0	dec. 20/-
,,	29 ..	22	0	0	No change
,,	30 ..	22	0	0	,, ,,
,,	31 ..	22	0	0	,, ,,

Spelter (ordinary).

		£	s.	d.	
Dec.	23 ..	13	15	0	dec. 1/3
,,	24 ..	13	15	0	No change
,,	29 ..	13	12	6	dec. 2/6
,,	30 ..	13	15	0	inc. 2/6
,,	31 ..	13	15	0	No change

Lead (English).

		£	s.	d.	
Dec.	23 ..	16	10	0	No change
,,	24 ..	16	10	0	,, ,,
,,	29 ..	16	10	0	,, ,,
,,	30 ..	16	10	0	,, ,,
,,	31 ..	16	5	0	dec. 5/-

AVERAGE MONTHLY PRICES OF WEST COAST HEMATITE MIXED NUMBERS DELIVERED SHEFFIELD.

Year	Jan.	Feb.	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.	Yearly average.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
1888	44 4	42 3	42 1½	42 0	41 2½	42 1½	42 6½	44 0	45 8½	44 6	44 6	45 3½	43 4
1889	44 4	45 2	47 3½	48 9½	48 6½	48 7½	50 1½	53 11	55 3	63 6	73 10	73 2	54 4½
1890	76 1½	65 1	63 3	55 1	53 9½	50 11	52 3½	56 4	58 0	58 2	57 5	54 4½	58 5
1891	52 9	50 10	48 11	47 9½	51 5	50 6	50 10	48 4	50 1	49 1½	48 3½	47 8	49 8½
1892	47 4	45 6	46 4½	47 8	49 5	50 4½	49 7½	49 10½	49 10½	48 8½	46 10	46 1½	48 2½
1893	46 0½	45 8	45 11	45 7	44 11	44 9½	44 10	45 3	45 0	44 6	44 7	45 8	45 3
1894	45 3	45 3	45 1½	45 1	43 11	43 11	43 9½	44 2	44 7½	43 7	43 5	43 3	44 3½
1895	42 8	42 5½	42 6	42 10	43 10	43 7½	44 10	45 11	49 11	48 9	47 7½	47 7½	45 2½
1896	47 0	48 9	48 9	48 2½	47 3	47 3	46 10	46 10	47 2	48 5	50 7	50 6	48 1½
1897	51 2	49 10	48 5	47 4	47 9½	48 6	47 0	47 3	47 3	47 0	48 3½	47 11	48 2
1898	48 9	48 10	49 4	49 8½	50 10	50 3½	51 0	52 5	53 11	55 8	57 3	56 10	52 1½
1899	59 1	59 9	57 7	59 6	64 7	70 10½	76 7½	72 2	74 3	75 0	78 1½	73 3	68 5
1900	75 3½	76 10	79 10	84 6	81 4	79 1½	83 4	81 5	79 11	76 10	77 8½	68 4	78 8
1901	60 2	59 0	57 9½	57 6½	57 8	57 4½	57 8	61 0	60 0½	59 9	58 7½	56 7	58 7½
1902	56 1	57 9½	59 3½	59 9	59 10½	60 0	60 0	60 8½	61 5	61 2	59 3	59 0	59 6
1903	58 5	58 8	61 1	59 5	57 10	57 3	56 7	56 3	55 9	54 8	52 4	52 4	56 8½
1904	52 8½	53 1	53 7	54 9	54 2	53 2½	52 9	52 5	52 2½	52 7	53 1	55 11½	53 5½
1905	57 9½	56 9	58 1	58 2	56 4	55 8	55 5½	56 7	61 0	68 9	69 9	70 11½	60 5½
1906	70 4½	65 2½	63 4½	63 9	64 5	64 6	64 1	66 2½	67 3	69 4½	72 4½	78 8½	67 5
1907	77 9	72 11	71 10	73 9	79 9½	76 9	77 9	78 4	75 11	72 9½	68 6	66 7	74 4
1908	62 7	59 1	61 6½	61 6½	61 4	59 1	57 9½	56 11	60 2	59 2	58 5½	57 7	59 7½
1909	51 4	56 5	55 3	56 1	56 4	57 0	56 8	58 0	61 0	61 1½	60 7½	61 4	58 1½
1910	64 0½	64 3½	66 10½	67 6½	66 2½	65 4	64 4½	65 6½	65 2	64 10½	64 6	65 6	65 4½
1911	66 9	66 1	64 10	63 1	62 1	62 0	61 2	62 2	62 1	61 1	61 10	64 0	63 1
1912	67 0	67 0	67 0	69 3	71 9½	72 11	75 9½	79 1½	82 2½	85 0	85 3½	86 6	75 9½
1913	86 6	86 6	86 3	85 0	83 6½	80 10½	78 1	76 10½	72 6	71 0	68 0	65 3	78 4½
1914	64 6	65 4½	65 6	64 11½	64 2½	64 0	64 0	68 11½	74 6½	71 0	65 4½	69 9½	66 10½
1915	78 9	100 6	103 1	113 6	111 9	114 0	116 3	115 2½	113 8½	121 1½	131 9½	139 6½	113 3
1916	135 0	135 0	133 4	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	129 2½
1917	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6
1918	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6
1919	127 6	127 6	127 6	127 6	180 6	184 3	195 4½	204 6	204 6	204 6	204 6	204 6	174 7
1920	224 9	235 0	245 0	275 0	290 0	295 0	295 0	295 0	295 0	295 0	295 0	280 0	284 11½
1921	263 4	228 4	180 0	180 0	180 0	160 0	160 0	157 6	142 0	128 6	121 0	115 6	167 9½
1922	125 0	117 6	115 0	115 0	115 0	115 0	113 1½	104 0	105 0	105 0	106 3	110 0	112 1½
1923	109 0½	116 5½	133 11½	138 3½	134 2	125 0	115 7½	111 9	110 0	110 0	113 11	115 0	119 5½
1924	115 0	115 0	114 4½	112 6	112 6	112 6	111 0	110 0	110 0	105 4½	102 6	102 6	110 3½
1925	102 6	102 6	100 0	98 6	97 6	95 1½	92 6	90 6	88 3	87 0	88 1½	88 9½	94 3½
1926	90 1½	90 0	89 8½	89 0	89 0	89 0	90 2½	91 9	94 0	97 2½	*	*	91 0
1927	95 4½	95 6	96 6	95 6	95 3	94 0	92 10½	91 6	90 6	90 6	90 6	89 6	93 1½
1928	85 0	85 3	85 5	85 0	85 3	84 9	84 0	83 9	84 0	84 0	83 1	82 6	84 4
1929	82 10½	83 6	85 0	86 9	87 0	87 0	87 3	87 2½	87 6	89 6	89 6	89 10½	86 11
1930	91 6	91 6	91 6	90 0	89 7½	88 0	87 7½	86 6	86 6	86 6	86 6	86 6	88 6½

* No prices available.

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